



**THE EFFECT OF MULTIPLE INTERVENTIONS ON ENVIRONMENTAL  
ATTITUDES AND BEHAVIORS**

THESIS

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Captain, USAF

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**Abstract**

New federal mandates require federal entities to reduce resource usage across the board. Additionally, commercial enterprises are evaluating methods of reducing resource consumption to reduce costs and become more ecologically friendly. In response, researchers have begun to evaluate the intentions and behaviors of individuals to determine how to encourage individual participation in reduction methods. This study used a quasi-experimental design of non-equivalent groups to evaluate the effects of Computer Based Training and persuasive speech on individual environmental attitudes and behavior. Using the Theory of Planned Behavior model to determine intentions and behaviors, this study utilized surveys to evaluate the relative effects of the interventions. The results provide managers with information that can help determine how to use intervention in their organizations to effectively change individual attitudes, intentions, and behaviors with respect to resource reduction. A key finding of this study was that Computer Based Training appears to have no short or long-term effects on environmental cognitive processes. Additionally, it was found that a persuasive speech was able to increase an individual's subjective norm which then showed a moderate link to long-term environmentally friendly behavior.

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Jeremy P. Kinne

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# THE EFFECT OF MULTIPLE INTERVENTIONS ON ENVIRONMENTAL ATTITUDES AND BEHAVIORS

## **I. Introduction**

In the past 50 to 60 years, discussions regarding environmental concerns have advanced past scientific inquiry and now occur in household conversation. Large scale environmental disasters such as the 1978 Love Canal scandal, 1986 Chernobyl Nuclear Power Plant disaster, 1989 Exxon Valdez oil spill, 1991 Kuwait oil field fires, and 2010 Gulf of Mexico oil spill have increased attention on an already compounded problem. Along with general concerns for the environment has come the issue of sustainability, or “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987). In fact, many governments and private companies have instituted mandates, regulations, policies, and instructions to become more sustainable and environmentally conscious. Responses have included costly equipment and material upgrades, expensive new construction endeavors utilizing “green” technologies, and the implementation of policy upgrades and regulations (Poulton, 2010); however, many of these efforts will be largely unsuccessful unless the people interacting with these new systems and technologies are able, trained, and willing to operate and service them appropriately (Gill et al., 2010). Therefore, understanding what motivates individuals to change their habits and behaviors is critically important to increase the understanding of sustainability and environmentalism.

## **Background**

The earth has been seen by some as an endless pool of resources to be utilized and consumed with only a few parks left to be enjoyed (Hopwood et al., 2005). Hardin (1968) argued that individuals utilize the earth as a commons. This meant the earth was viewed as a common pool of resources to be utilized for individual use without regard to the greater population. This theory has been supported throughout history, one of the most notable incidents being the tragedy of Easter Island where the indigenous people consumed all of the available resources and subsequently went extinct (Nersesian, 2007).

Although people generally tend to consume goods without regard for the consequences, leaders throughout history have attempted to temper these actions with mandates that protect the environment. Records of such attempts go back to 1306 when King Edward I banned the burning of coal in London under penalty of death due to the immense amount of smog that was created (Nersesian, 2007). Unfortunately, the ban was not effective, as most of the inhabitants of London could not afford alternative sources of energy such as wood. Presently, similar legislation is available to help protect the environment, although the punishment is significantly less than death. The United States government has passed legislation requiring the federal government to become more environmentally friendly. The Energy Policy Act of 2005 establishes policy on energy usage, Executive Orders 13423 and 13514 mandate the reduction of energy and water usage, and the Energy Independence and Security Act promotes multiple methods of energy usage reduction (Wise, 2011). Although legislation can be extremely effective in changing behavior, it does not necessarily change attitudes; therefore, in order to continue affecting change, the concept of attitude should be studied further (Steptoe et al., 2002).

Attitudes can be affected by any number of background issues. Several studies have indicated that females tend to have stronger pro-environmental attitudes and behaviors than men (Zelezny et al., 2000). Other studies have shown negative correlations between religion and environmental attitudes, although several of the studies tend to reflect only the Christian and Jewish faiths and not any of the other large world religions (Guth et al., 1995; Eckberg & Blocker, 1996; Greeley, 1993). Other factors that affect pro-environmental attitudes can include wealth (Griskevicius et al., 2010) and culture (Martinez-Alier, 2002).

Stern (2000) posits that there are four categories of environmentally significant behavior. The first category is environmental activism which includes active participation in environmental organizations. The next category is public sphere which consists of supporting and accepting public policies. Another category is private sphere which involves the use of environmentally-friendly consumer products. The final category is “other behaviors” which includes anything that does not fit into the first three categories. Several decision-making models exist to determine why an individual would effectively “switch” into one of these categories. The New Environmental Paradigm (NEP) theorizes that people will realize that the world is an island of finite resources and therefore become more concerned with protecting them (Dunlap & Van Liere, 1978). The NEP provides a scale of measures designed to predict how concerned a person is, but not necessarily why he or she decided to be concerned initially.

The Theory of Reasoned Action (TRA) is a decision-making model which predicts how people consciously decide upon the actions they execute (Fishbein & Ajzen, 1975). TRA theorizes that people evaluate the intended behavior internally and weigh

that opinion against what they believe others think about the intended behavior. This perception of what others think about a particular behavior is known as subjective norm. Unfortunately, the TRA model did not consider the fact that even if an individual believes the behavior is important and that other people believe it is important, the individual may not believe that he or she is able to control the behavior and therefore would still not participate in it. Therefore, the Theory of Planned Behavior (TPB) was created to include perceived behavioral control as an influence on attitude and behavior (Ajzen, 1985). The TPB has since been empirically validated as a model over a range of applications (Bamberg, 2003).

In order to change or sway an individual's evaluation of a behavior under the TRA or TPB, some type of intervention is required. Many modes of interventions exist, but some common ones are mandates, information, persuasion (De Young, 1993). Mandates come in the form of legislation or laws that require people to perform certain behaviors. They have been shown to be extremely effective in changing behaviors, but are not always successful at changing the attitudes behind the behavior (Steptoe et al., 2002). Environmental mandates have been around for centuries (Nersesian, 2007) in order to protect the greater population, but little research has been conducted on the specific effects of mandates on environmental attitudes.

For informational interventions, the primary types are personal or mass public, experiential, and educational. De Young (1993) showed that informational interventions can be successful at changing behaviors, but Abrahamse et al. (2005) indicated that those new behaviors tend not to last. Abrahamse et al. (2005) also indicated that mass media campaigns were successful in increasing knowledge, but not at changing behaviors or

attitudes. Residential educational classes utilize experiential interventions and have been shown to provide more long-term changes in attitudes and behaviors (Stern et al., 2008). Computer-based learning is a relatively new educational type of intervention that requires further study (DeBord et al., 2004), but current studies show that it is an effective method of increasing knowledge and changing behaviors (Burgess 2003; Smallwood & Zargari, 2000).

Computer-based learning is an upcoming medium of informational intervention that is rapidly increasing in use. This medium has grown faster than studies have been able to support, thereby requiring further study of their usefulness and effectiveness (DeBord et al., 2004). Current studies show that web-based learning can be an effective tool to not only increase knowledge but also change behavior (Burgess, 2003; Smallwood & Zargari, 2000); however, many of these studies reflect educational uses rather than the Computer-Based Training (CBT) modules used in many organizations.

Persuasive communications are those which help push an individual's attitude towards a more desired state by producing automatic reactions to certain instigators (Cialdini, 2008). These types of communications come in the form of commitment (Burn & Oskamp, 1986), feedback (Abrahamse et al., 2005), and social proofs (Brown et al., 2010); however, little literature exists on the combination of these factors in one study.

## **Problem Statement**

Although politicians are starting to promote public environmental policy, it is the individuals supporting the policy that truly matter. It is becoming increasingly more important to determine ways to change environmental attitudes to ensure occupants can



properly utilize pro-environmental technologies and processes. Several studies have focused on singular methods of changing behavior, such as commitment (Burn & Oskamp, 1986), information (Abrahamse et al., 2005), persuasion (Brown et al., 2010), and in-resident courses (Stern et al., 2008); however, few studies have evaluated the effects of combining several of these techniques. Additionally, little research currently exists on Computer-Based Training modules and the effects provided by such modules. Many companies use Computer-Based Training modules or speeches as a form of behavior intervention despite the relative lack of research of these types of intervention.

### **Research Questions**

The overall objective of this research was to evaluate the effects of multiple interventions on environmental attitudes and behaviors. Factors within the Theory of Planned Behavior were thus evaluated and examined over the course of two months while different interventions were conducted. To evaluate the effects of the respective interventions, the following specific investigative questions were posed:

- What level of prediction do the cognitive processes of environmentalism have upon environmentally friendly behaviors?
- How strong is subjective norm in affecting environmental attitudes and perceived behavioral control of environmentally friendly behaviors?
- What changes can an intervention create in environmental cognitive processes and are those changes sustainable?
- How long can changes caused by an intervention last?

## **Methodology**

To evaluate these investigative questions, this research used a quasi-experimental design of non-equivalent groups in which two intervention methods were developed. The first intervention was an influential briefing based upon the methods of influence developed by Cialdini (2008). The intervention contained methods such as social proofs, public commitments, likability, similarity, and authority. The second intervention was a CBT based upon a similar training program already in place at an existing location. This intervention method was simply informational in nature and delivered both general and base-specific facts. Both interventions delivered the same type of information, but employed different delivery methods.

Each intervention was implemented in separate Air Force Civil Engineer squadrons that were of similar size, function, distribution, and geographic location to ensure they represented similar populations. To examine the impact of each type of intervention, an identical survey was administered within each organization at three different points in time. The survey was developed based upon the five factors within the Theory of Planned Behavior (Ajzen, 1985): attitude, subjective norm, perceived behavioral control, intention, and behavior. Additionally, several items were added to evaluate the demographics of the sample to include age, gender, and rank. Participation in the survey was voluntary and all demographic data were kept anonymous. In order to stay anonymous while still evaluating individual changes in attitudes, identifiers were created by the users for the purposes of linking time-sensitive data only.

The initial survey was administered prior to any intervention at either base to establish a baseline. After the intervention occurred, a follow-up survey was immediately

administered. The final survey was administered two months after the interventions to determine the longevity of any changes. The data from all three surveys were compiled and statistically analyzed through structural equation modeling and paired sample t-tests to evaluate the effect of the interventions and the correlation between the interventions and the factors of the Theory of Planned Behavior.

### **Assumptions/Limitations**

Several assumptions must be made in order to conduct research of this type. One such assumption is that the results from the two squadrons can be generalized to other organizations or the larger public. Another assumption is that the items used from previous studies are valid for use in this survey. A limitation of this research is that little to no usage data were collected which may otherwise show a disparity between reported intentions and actual behavior. This lack of data means that an assumption must be made that self-reported intentions reflect actual behavior.

### **Significance of Study**

Results of this study will help organizations understand the factors that help influence an individual's willingness to act in a pro-environmental manner. By understanding the motivating and influential powers behind individual actions, organizations and managers can perform new strategies in creating environmentally conscious employees. The desire is to increase environmental conscientiousness which, in turn, will affect further reduction of energy usage, utility bills, and damage to the environment while helping to meet current and upcoming federal environmental mandates.

Additionally, the use of interventions to affect behavior in organizations has become somewhat commonplace. The creation of these interventions cost the organization time, money, and effort which may not be worth the investment. This study could be beneficial to organizations wishing to increase environmental conscientiousness by providing insight into the effects of intervention programs on environmental attitudes and behaviors thereby enabling consolidation of costs and efforts into an intervention that provides more of a desired effect. Results of this study will help shed light on the usefulness of such interventions and whether they are worth the time and money spent.

### **Organization/Purpose of Remaining Chapters**

The following chapters will examine the research supporting decision-making models, individual factors of environmental concern, and intervention methods. Chapter 2 will explore the current literature concerning these factors which feed into environmental attitudes. After the literature has been discussed, Chapter 3 will detail the methodology utilized to evaluate the effect of intervention methods on changing environmental attitudes. Following the collection of data with the survey, Chapter 4 will provide a statistical analysis of the results and discuss the raw data. Finally, Chapter 5 will discuss the meaning of the analysis done in Chapter 4 and provide recommendations regarding effective methods to change individual attitudes on the environment.

## **II. Literature Review**

This chapter reviews the existing literature concerning the formation of environmental attitudes. First, the psychology behind how people frame their thoughts and actions will be discussed. This psychology, which includes mental models and predictors of behavior, is important to understand as it aids in understanding why certain influences work and others do not. Secondly, types of interventions will be explored to evaluate their past effectiveness and to determine which ones could likely be combined into a single intervention. Through each section, hypotheses will be presented with respect to the research.

### **Psychology**

Understanding the reasons that individuals choose to act in a particular way is very important to being able to change that behavior. Therefore, several theories have emerged regarding the models that individuals use to make decisions. This section will discuss some of these behavioral models and how they can be utilized.

#### ***Theory of Reasoned Action***

Initially, the field of psychology maintained two major schools of thought: behaviorism and cognition (Bargh & Ferguson, 2000). Behaviorism is the theory of learning through conditioning and experiences (Watson, 1913). Watson summed up his concept of behaviorism in the following statement:

Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to

become any type of specialist I might select--doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors. (Watson, 1924:82)

However, behaviorism left out the ideas of conscious thought, experience, and emotion which caused other psychologists to posit new theories (Bargh & Ferguson, 2000).

Therefore, cognitive science, or the study of intelligence and the resultant computational processes (Posner, 1993), was developed.

The concept of cognitive behavior was solidified in the Theory of Reasoned Action (TRA), which is a model that predicts the manner in which people form the behaviors they project (Ajzen & Fishbein, 1980). As shown in Figure 1, Ajzen & Fishbein (1980) theorize that people evaluate the intended behavior internally and weigh their opinion against what they believe others think about the intended behavior in order to reach a decision. These two considerations are referred to as behavioral beliefs and normative beliefs (Heath & Gifford, 2002). Behavioral beliefs are those that an individual has which governs his or her opinion of the outcome of the behavior, while normative beliefs are the opinions the individual has regarding what significant others will think of him or her after performing the behavior (Heath & Gifford, 2002). Normative beliefs, also known as peer pressure, have been long known to be important in the development of group goals in many situations (Kandel & Lazear, 1992). The combination of these two beliefs has shown that intentions that are close in time to the actual performance of the behavior are one of the strongest predictors of behavior (Vining & Ebreo, 2002).

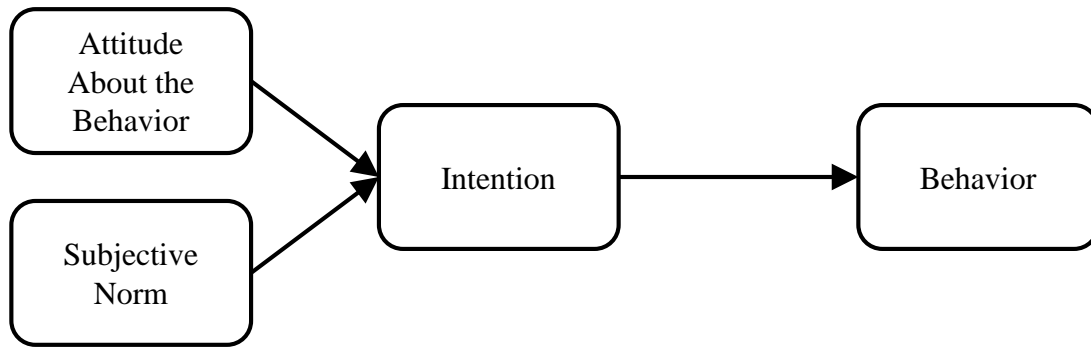


Figure 1: Theory of Reasoned Action (Ajzen & Fishbein, 1980)

### ***Theory of Planned Behavior***

Despite the overwhelming acceptance of TRA, issues arose since it did not consider the importance of control beliefs which characterize the belief of the individual that he or she is able to control the behavior (Heath & Gifford, 2002). This prompted Ajzen (1985) to refine his model and account for this oversight. Named the Theory of Planned Behavior (TPB), this newer model is a derivative of the former TRA and includes perceived behavioral control as a third factor of influence on intention (Vining & Ebreo, 2002). Shown in Figure 2, the TPB indicates that an individual may choose at any time to participate in a behavior simply because he or she wants to or is able to. Perceived behavioral control can account for a vast difference between typical intentions and actions as described in the TRA (Ajzen, 2002). It is for this reason that the TPB has become one of the most popular tools for predicting behavior (Ajzen & Gilbert, 2008). It is also important to note that attitude, subjective norm, and behavior are not always equally weighted in their importance on intention and therefore may not always be statistically important as a predictor (Ajzen, 1991). The TPB has also had success in

applications of evaluating and predicting pro-environmental behavior. In studies of individual conservation behavior (Harland, Staats, & Wilke, 1999) and water conservation (Lam, 1999), it was determined that behavior beliefs, normative beliefs, and control beliefs were all effective predictors of pro-environmental attitudes.

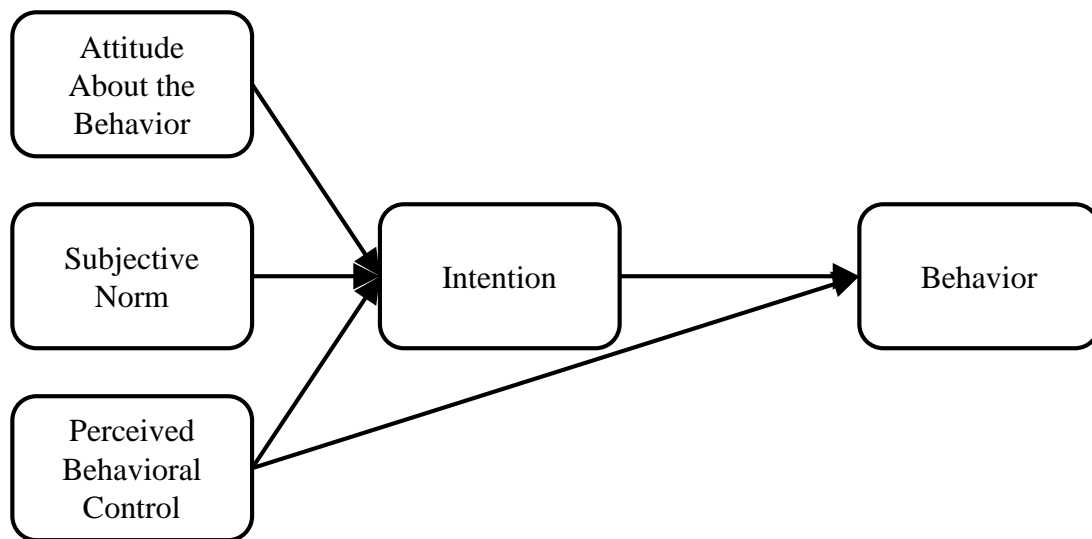


Figure 2: Theory of Planned Behavior (Ajzen, 1985)

The Theory of Planned Behavior's addition of perceived behavioral control has been illustrated in real-world examples. After the Brundtland Commission found that poverty stricken nations were becoming less sustainable as they were doing whatever was necessary to provide for themselves and their families (United Nations, 1987), Martinez-Alier (2002) rejected the idea. Martinez-Alier (2002) indicated that there are many examples of disadvantaged individuals speaking out against wealthy individuals who were causing environmental destruction for profit. This concept, the Environmentalism



of the Poor, overturned the idea that environmental protection and conservation can occur only after the material necessities of life are provided for. Instead, in order for individuals to be concerned for the environment, they need only the mindset that nature is finite, that destruction of it may mean destruction of the population, and that they have control over the outcome. This theory reinforces that of the Theory of Planned Behavior in that if there is perceived behavioral control over the outcome of a given action, the individual will be more likely to participate in that action.

In the Theory of Planned Behavior, there is a direct link between intention and behavior; however, this link is not always found within the same time period. The condition for this link continuing to exist over a given time period is that the intention and perceived behavioral control of an action must stay constant between the time that the intention and perceived behavioral control were assessed and when the actual behavior was observed (Azjen, 1991). Additionally, it is theorized that perceived behavioral control can have an effect on later behavior (Azjen, 1991). Since it is theorized that there can be a delay in behavior within the Theory of Planned Behavior, the following time-lagged hypotheses, also shown in Figure 3, are presented to address the first investigative question (IQ).

***IQ1:*** What level of prediction do the cognitive processes of environmentalism have upon environmentally friendly behaviors?

***Hypothesis 1a:*** Past cognitive processes of environmentalism will cause environmentally friendly behaviors in a later time period.

***Hypothesis 1b:*** An intervention will have no immediate effect on behavior.

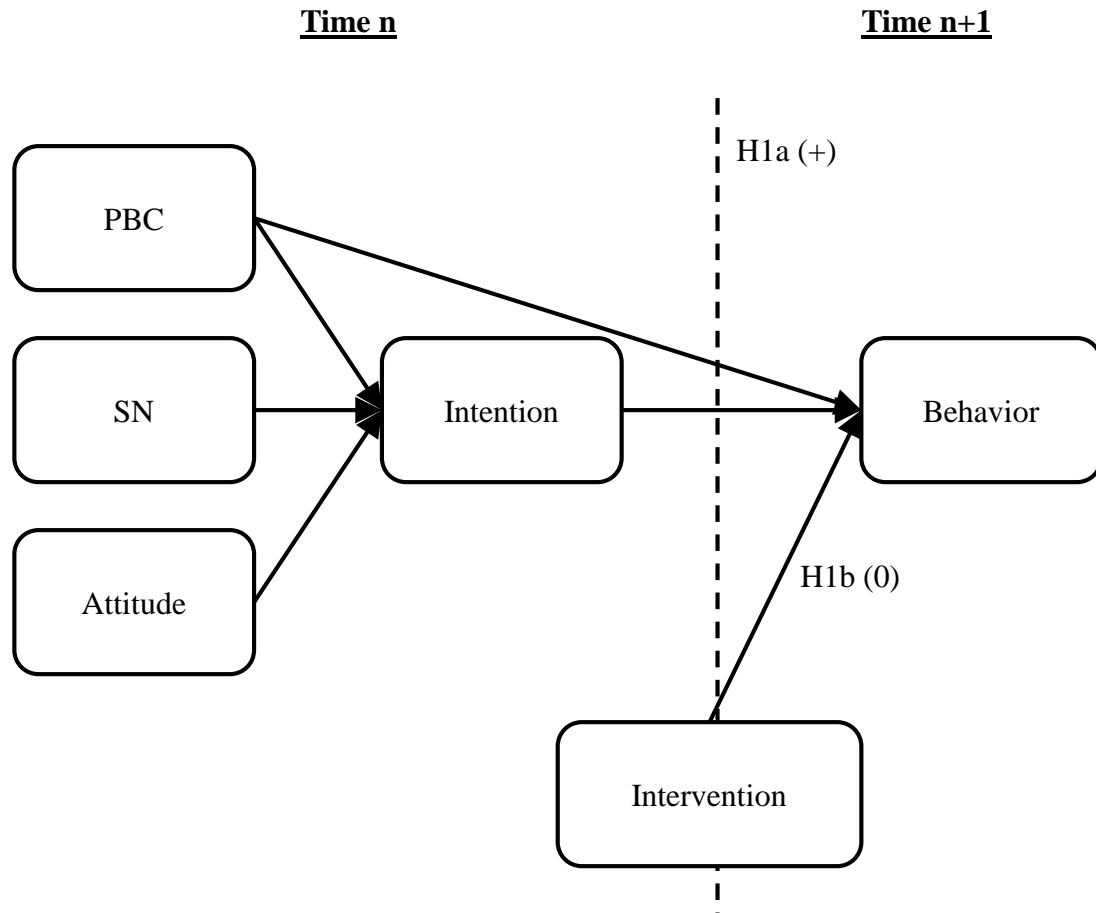


Figure 3: Hypothesis 1

### ***Social Norms Theory***

Social norms theory describes how individuals make assumptions about the attitudes or behaviors of peers, community members, and society at large and seek to conform to those assumptions (Berkowitz, 2002). Also known as pluralistic ignorance, the theory postulates that individuals may perceive a belief as the social norm. If the perceived belief is different than the individual's, the individuals has one of three options: change their attitudes to match the perceived norm, change their perception of the social

norm, or disassociate themselves from the group and find a group closer to their own mode of thinking (Prentice and Miller, 1993). Typically, the primary option chosen by an individual is to change their own attitude toward that of the perceived social norm due to feelings of belonging and affiliation with the group (Festinger, 1954). Many times, this behavior is also reinforced as an individual who sees others acting in an identical manner will assume it is simply reflecting their own personal attitudes and feelings (Prentice and Miller, 1993).

Social norms theory can be seen in the patterns of Prius purchases. Griskevicius et al. (2010) reported that the number one reason that Americans said they purchased a Prius was to make a statement of pro-environmentalism. In effect, individuals purchased a Prius because they perceived the social norm to be one which required pro-environmentalism. To fit this social norm, a Prius was purchased by the individual so others would perceive him or her to be pro-environmental. The same study showed that if an individual is motivated by status or social norms, they are more likely to desire to utilize environmentally friendly products in public than in private, especially when the product was less luxurious than the less environmentally friendly counterpart. That is, the individual would only utilize pro-environmental products when others could see him or her using them to meet the social norm, not necessarily because the individual was truly concerned about the environment. Status motives, therefore, can play an important role in promoting use of environmentally friendly products. The idea that status motives are important to the use of pro-environmental products introduces the possibility that pro-environmental product use could be increased if status motives and social norms could be altered.

Social norms theory shows how an individual's perception of others can lead to a change in their own attitude toward a given behavior. This connection between subjective norm and attitude could have a large effect on the Theory of Planned Behavior. As such, the following hypotheses, also shown in Figure 4, are presented to address the second IQ.

***IQ2:*** How strong is subjective norm in affecting environmental attitudes and perceived behavioral control of environmentally friendly actions?

***Hypothesis 2a:*** In any given time period, views of public concern for the environment will cause individual perceived behavioral control of environmentally friendly actions.

***Hypothesis 2b:*** In any given time period, views of public concern for the environment will cause individual environmental attitudes.

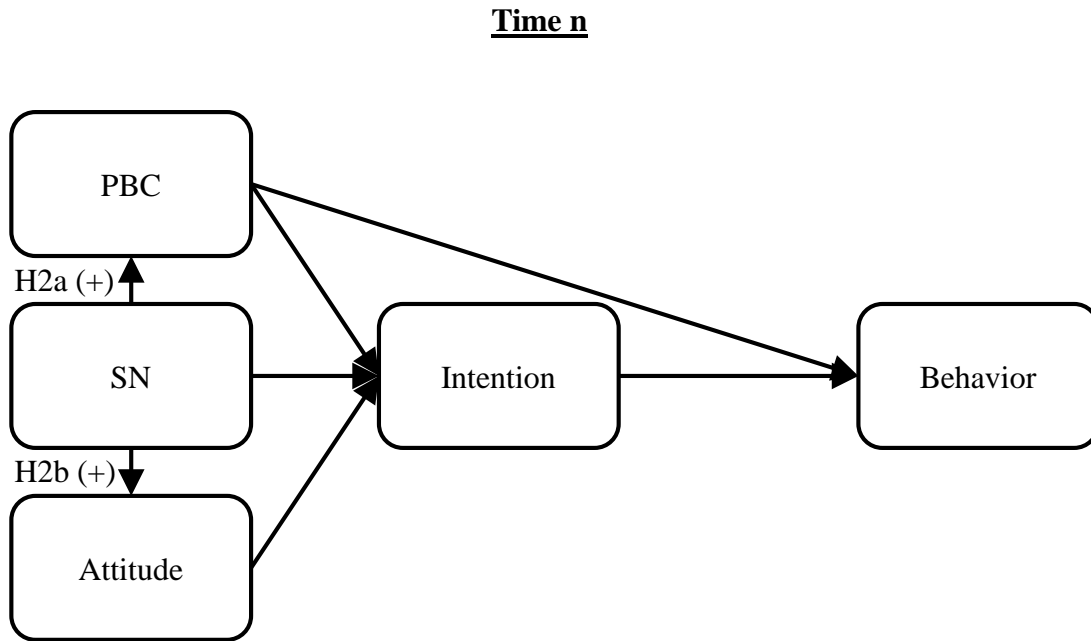


Figure 4: Hypothesis 2

## **Interventions**

As the world continues to shift its view of the environment and nature, more technologies become available for use (Poulton, 2010); however, the use of these technologies lies with the individual. Therefore, it is important to evaluate the effectiveness of interventions as a method of changing individual environmental attitudes. Even under the TRA or TPB, there still must be some type of intervention to change attitudes. Although there are many modes of interventions, some common forms are mandates, information, and persuasion (De Young, 1993).

## ***Mandates***

Mandates are legislative actions which require individuals to either perform or not perform certain behaviors. In generic terms, mandates can be extremely effective at

changing main behaviors, but can fall short at changing attitudes which support the desired behavior (Steptoe et al., 2002). Therefore, mandates are effective only at changing behavior temporarily. Once the mandates are removed, the original behavior is likely to return (De Young, 1993). Similarly, if leadership no longer supports or emulates a mandate, the desired behavior is likely to fade and the original behavior is likely to return (Beer et al., 1990). In terms of the TPB, the use of mandates does not account for the behavioral, normative, or control beliefs in an individual.

### ***Informational Interventions***

Informational interventions consist of information which is distributed in an attempt to increase general knowledge, thereby affecting behavior (DeYoung, 1993). Another concept of informational interventions is that people are already well-informed, but they fail to know which specific behavior to adopt (DeYoung, 1993). Informational interventions come in the form of leaflets, public broadcasts, education, training, etc. They can be successful at changing behaviors if the information is pertinent to the individual receiving it (Gill et al., 2010), but those new behaviors can fade quickly with time (Abrahamse et al., 2005). This means that informational interventions can be effective at temporarily increasing knowledge or awareness of a desired subject, but that they fail to maintain that level of awareness over the long-term. Similarly, mass media campaigns are generally successful at enhancing individual knowledge of a subject, but once again fall short at changing behaviors or attitudes in both the short and long-term (Abrahamse et al., 2005). Educational classes which have an in-resident portion have been shown to provide better long-term attitudinal and behavioral changes, although they still require periodic follow-up to keep individuals from reverting to their former

behavior (Stern et al., 2008). Computer-based learning is a relatively new frontier that is increasing rapidly in usage, thereby requiring further study (DeBord et al., 2004).

Current studies show that web-based learning is an effective method of not only increasing knowledge but also changing behavior (Burgess 2003; Smallwood & Zargari, 2000); however, most of these studies tend to reflect professional or educational settings rather than the Computer-Based Trainings (CBT) modules used in many organizations. These modules tend to be more informational in nature.

### ***Persuasive Communications***

Persuasive communications are designed to affect an individual's attitude towards a desired state by reactions to certain instigators (Cialdini, 2008). Public commitment is one of the most common types of persuasive communications and is intended to trigger an individual's sense of consistency (Cialdini, 2008; Burn & Oskamp, 1986). Typically linked to a specific goal, public commitments have been shown to lower rates of energy usage (Burn & Oskamp, 1986) and provide rapid change in behavior (DeYoung, 1993); however, reminders of past bad behaviors can result in shorter periods of changed behavior (Vining & Ebreo, 2002).

Feedback is another form of persuasive intervention that has been shown to be effective (Abrahamse et al., 2005). Feedback provides information either during or following a desired action. This feedback enables the individual make an informed decision on whether to continue a given behavior or to make adjustments that would benefit the preferred outcome. For example, information on how much energy has been saved has been indicated to be effective at reducing the rate of energy use in residential settings (Gill et al., 2010). Similar to public commitment, feedback is most effective at

increasing energy savings if coupled with a specific and difficult goal (Abrahamse et al., 2005).

Social proofs, occasionally referred to as modeling, use role models to perform a behavior with the intent that others will follow. Role modeling has been shown to be beneficial in reducing littering in public places and, conversely, littering has been shown to increase if litter already exists in a certain area (Brown et al., 2010). Social proofs broadcast on television have also had beneficial effects on energy reduction (Abrahamse et al., 2005). However, there are potentially adverse consequences to utilizing social proofs. One such danger of role-modeling can involve psychological reactance in which an individual feels constrained and therefore acts out in a manner opposite than desired (DeYoung, 1993).

Although much research has been conducted on interventions, little literature exists on the combination of several of these factors in one study. Specific and measurable goals are a common theme for many interventions (Steptoe et al., 2002; Burn & Oskamp, 1986; Abrahamse et al., 2005) but few other factors are combined. Additionally, there is little research comparing intervention types. Many organizations do not have the resources to perform multiple interventions for the same objective so it is important to look at the effects of each type and compare them. Due to this lack in the combination of intervention factors and comparison of intervention types, the following hypotheses, also shown in Figure 5, are presented to address the third IQ.

**RQ3:** What changes can an intervention create in environmental cognitive processes and are those changes sustainable?

**Hypothesis 3a:** Persuasive speech will have the same effect as a short, informational CBT on perceived behavioral control.



**Hypothesis 3b:** Persuasive speech will increase subjective norm more than a short, informational CBT.

**Hypothesis 3c:** Persuasive speech will increase environmental attitude more than a short, informational CBT.

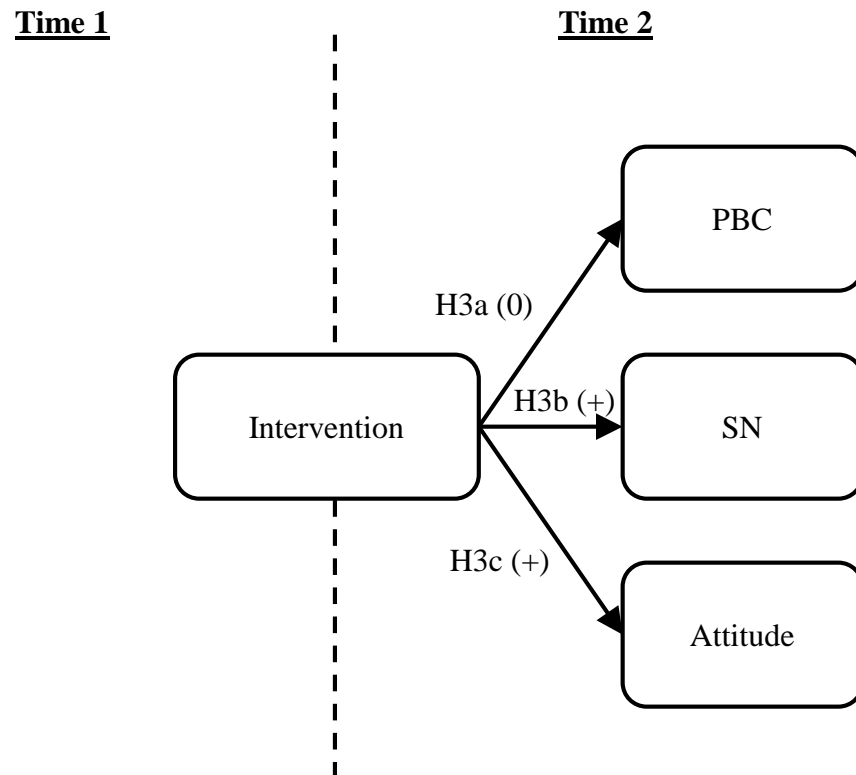


Figure 5: Hypothesis 3

### ***Time-Delayed Effects of Interventions***

The goal of most behavioral interventions is to affect long-term change. In other situations, immediate change in behavior can also be a desired effect. Several studies have thus been conducted to evaluate the immediate and long-term effects of different

interventions. It is important to consider whether an intervention will have an immediate effect and to evaluate the sustainment of such changes over time.

Quine et al. (2001) utilized the Theory of Planned Behavior to affect intentions and behaviors of school-age cyclists in order to increase helmet usage. The study concluded that changes in the factors of the TPB remained significant over a long period of time, indicating that interventions can be effective in sustaining long-term change. In a different study, Stead et al. (2005) determined that interventions specifically designed to affect the factors of the TPB will have more success in long-term changes, primarily in changing attitudes. Similarly, Dwyer et al. (1993) performed a meta-analysis of environmental interventions and discovered that, although many intervention studies do not evaluate results for longer than a week or two past the intervention, the few studies examining long-term results indicated that utilization of persuasive measures created sustained changes over the long-term. Many of the effective interventions provided continuous input to the participants over the entire period of the study through the use of goals and commitments. Stern et al. (2008) also showed that many aspects of environmentalism can be changed and sustained over the long-term through the use of interventions. Their study involved residential educational classes over a period of several days which were shown to create long-term changes.

Long-term changes are typically a desired effect of interventions. This study monitored the effects of different interventions over time. The following hypotheses, also shown in Figure 6, are presented to address the fourth IQ.

***RQ4:*** How long can changes caused by an intervention last?

***Hypothesis 4a:*** The perceived behavioral control of environmentally friendly actions will fade over a period of two months after the intervention.

***Hypothesis 4b:*** The perception of the importance of environmentally friendly actions will fade over a period of two months after the intervention.

***Hypothesis 4c:*** Individual environmental attitudes will fade over a period of two months after the intervention.

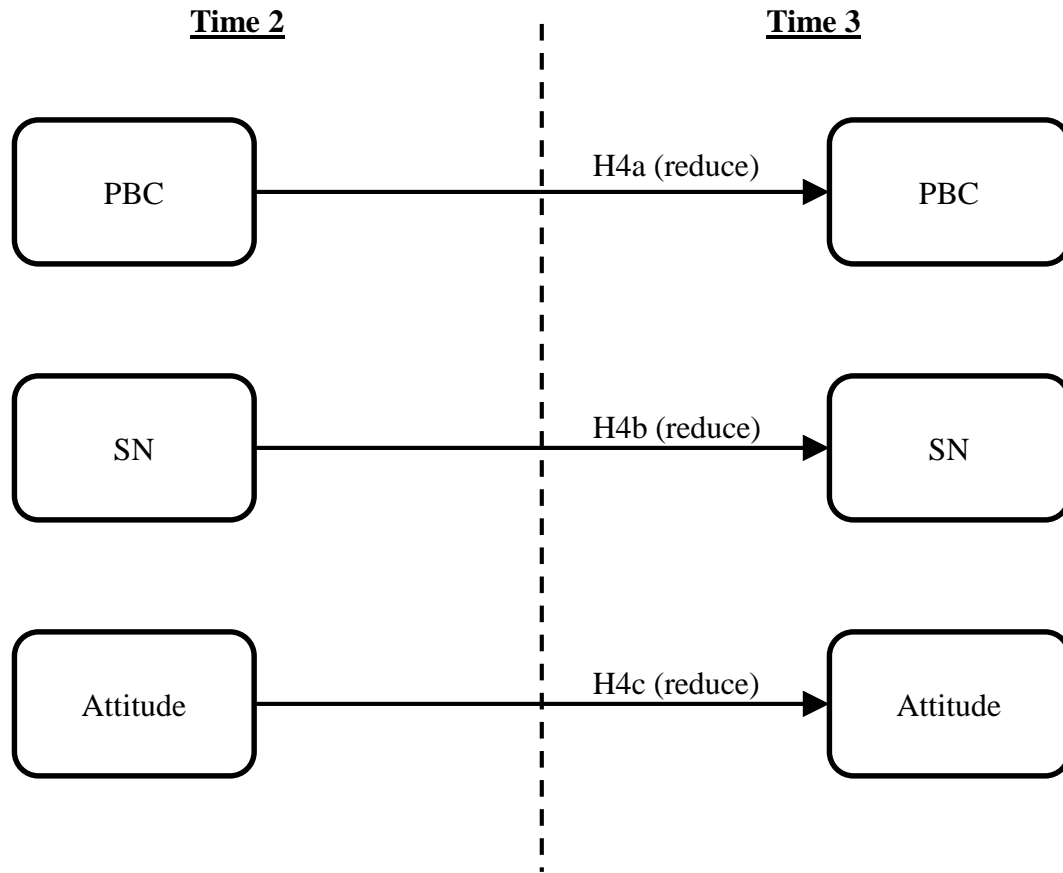


Figure 6: Hypothesis 4

## Summary

Four sets of hypotheses have been developed and are possible outcomes of this study. Although many studies combine feedback with other interventions (Steptoe et al., 2002; Burn & Oskamp, 1986; Abrahamse et al., 2005), few studies look at combining other persuasive or informational facets of interventions. Additionally, few studies examine the effects of informational CBT modules. This research explored not only at the effect of combining multiple aspects of persuasion, but compared the results against a

CBT with similar information to determine the comparative effects of computer-based learning. Figure 7 depicts all of the hypotheses presented in this chapter.

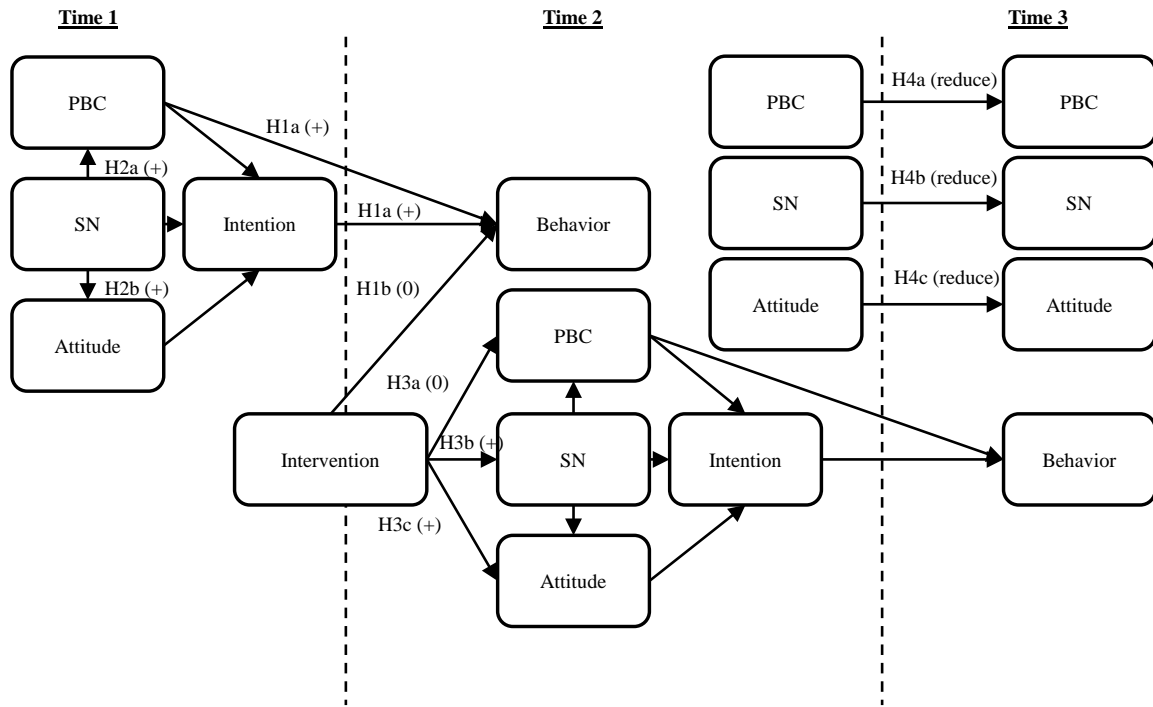


Figure 7: Proposed Relationships of Interventions and the TPB

### **III. Methodology**

This chapter explains the methodology that was utilized when evaluating the hypotheses established in the literature review section. The first section gives a brief description of the assumptions and boundary conditions used in creating this study. The second and third sections describe the independent and dependent variables, respectively. The fourth section describes the development of the interventions, while the fifth section reviews the development of the survey instrument and how it was utilized. Finally, the last section discusses the statistical analysis used to generate the results that will be discussed in the next chapter.

#### **Assumptions and Boundary Conditions**

The first assumption was that of generalization: that the results from the two respective squadrons could be generalized to other organizations or the larger public. This assumption is important in that it allows for the results to be applied to other situations. Based upon this assumption, the boundary condition of this research was set to reflect any organization in the United States of America as it was assumed that members within the United States Air Force would have a similar cultural background and attitude as the general population. It has been shown that the United States military reflects the demographic diversity of the United States population in race, ethnicity, religion, and socioeconomics (Segal & Segal, 2004). Although there are no studies that evaluate the similarity of attitudes between the US military and the general population, it is assumed from the similar demographic diversity that the military is essentially a

microcosm of the general population and therefore would likely have similar environmental attitudes to that of the general population.

Another assumption was that the New Ecological Paradigm can be utilized as a single indicator of environmental concern. Though the NEP consists of five individual categories, it was assumed to be used as a single factor when evaluating overall environmental concern (Dunlap et al., 2000). In this manner, environmental attitude was measured using the NEP as a whole rather than evaluating the factors individually.

As with many experimental studies or research, there was a possibility that the user might report behaviors that were not actually performed. Therefore, it was assumed that self-reported behavior and intentions reflect actual behavior and intention. This assumption must be made as no usage data could be collected within the timeframe desired.

One more assumption was that testing effects upon the participants would be minimal. When conducting studies of groups, it is possible to “train” the participants as to the desired answer by providing them the same survey multiple times. This can cause false results which could invalidate the study; however, anonymity of the study helps reduce this effect as individual participants cannot be credited with responding “correctly” or “incorrectly” to the measures. Therefore, it was assumed that the results of each survey item are true and not artificially adjusted due to testing effects.

The final assumption was that external factors do not affect environmental attitudes and behaviors for the purposes of this study. There is no way to control for the complex interactions of society and individuals; therefore, it is difficult to determine what effects, if any, those interactions might have upon attitudes and behaviors. Although the

energy managers at each base were asked not to run any additional environmental programs during the period of the study, other external influences such as television advertisements or state-run programs could not be controlled for; therefore, it was assumed that no other external factors influenced the outcome of this study.

### **Independent Variables**

This study evaluated environmental intentions and behaviors by examining different types of interventions through the Theory of Planned Behavior (TPB) lens. Therefore, the type of intervention was the only independent variable in the study. The intervention variable was thus defined as the type of intervention the individual received. It was a binary variable in which a zero represents a persuasive speech intervention and a one represents an informational computer-based training intervention.

### **Dependent Variables**

Five dependent variables were examined in this study: environmental attitude, subjective norm about the environment, perceived behavioral control about the environment, environmental intention, and environmental behavior. Environmental attitude is a measure of how concerned an individual is about the environment and its fragility. Subjective norm about the environment concerns the individual's perception about the environmental concern of others. Perceived behavioral control about the environment deals with the perception of control an individual has over a specific behavior. For the context of this study, perceived behavioral control was defined as the individual's perception of whether they feel their efforts have any effect on the environment. Environmental intentions are the willingness and desire to participate in



environmentally friendly activities such as recycling, carpooling, energy conservation, etc. Similarly, environmental behavior is the actual participation in those very same activities.

### **Development of Interventions**

The design of this study followed the quasi-experiment design of non-equivalent groups with a slight modification of the basic form. In the basic form of this design, two similar groups were given a pre- and a post-test and then evaluated to determine the effects of the intervention; however, in this study, rather than utilizing a control group against which to measure a single intervention, two different types of interventions were utilized and then compared against each other. Additionally, there was a second post-test to evaluate long-term changes in attitudes and intentions. This test is modeled in Table 1 where O indicates a test, X indicates one type of intervention, Y indicates a different type of intervention, and N indicates the number of individuals eligible to receive each intervention. By utilizing the non-equivalent groups design for quasi-experiments, the effects of intervention X were compared against the effects of intervention Y.

Table 1: Non-equivalent groups experiment design

Experiment	N	Design
1	$N_1$	O X O O
2	$N_2$	O Y O O

X: First intervention type

Y: Second intervention type

O: Test

N: Number individuals eligible to test

### *Persuasive Speech*

A persuasive speech was developed and delivered to the first base. This speech was developed using concepts from Cialdini's (2008) work on influence. The speech was created to incorporate portions of liking, authority, social proof, and commitment. Since the average age of a military member in the Air Force is 30 years old, the concepts of liking and similarity were accomplished by utilizing a 29 year old military speaker from the United States Air Force, incorporating pieces of pop-culture in the presentation, and incorporating jokes and humor within the speech. Authority was accomplished by having the unit commander introduce the speaker in a positive manner in which the specific accomplishments of the member were detailed to enhance the appearance of authority. Social proof was accomplished by giving case examples of others who are already reducing energy usage and including graphs of energy usage showing decreasing rates. Finally, commitment was accomplished by having the members sign a written commitment form which stated that they were committing to reducing their own personal energy usage in order to obtain a goal of 3% energy reduction per month. The

presentation was developed in Microsoft PowerPoint and delivered during a squadron Commander's Call to ensure maximum participation and attendance. Commitment worksheets were handed out to members prior to the speech and were explained during the presentation. Members were asked to sign the commitment worksheet and return them after the meeting concluded. The members were told that the commitment percentage of the unit would be included in a report about the unit's commitment to energy usage.

### ***Computer-Based Training Module***

A Computer-Based Training (CBT) module was created based upon an existing CBT in use at another Air Force base. This CBT was designed to inform the user of energy specific initiatives, requirements, and suggestions. The CBT for this study was created using Microsoft PowerPoint and was then emailed to participants at the second base by one of the unit's officers. The function and use of the CBT was briefed to the unit's leadership with the intent that it be disseminated throughout the unit. No elements of persuasion were included within the CBT, and therefore no commitment worksheet was delivered to the members. This was done to isolate the effects of persuasion conducted in the persuasive speech.

### **Survey Development and Administration**

A 45-item questionnaire was created to measure the desired factors. A full copy of the questionnaire is provided in Appendix A. The following section provides an overview on the development of the survey tool and the factors within it. It also describes how the survey tool was administered.

### ***Survey development***

From a review of the literature on environmental attitudes, environmental behaviors, influence, and intentions, the Theory of Planned Behavior (TPB) developed by Ajzen (1985) was used to determine which factors would be included in the survey. Five factors were utilized from the TPB: environmental attitude, environmental behavior, environmental intention, subjective norm, and perceived behavioral control. Using these factors, items were found from previously validated studies and incorporated into this study. Each of the items were provided response options based upon a 5-point Likert scale: (1) Strongly Disagree, (2) Mildly Disagree, (3) Unsure, (4) Mildly Agree, and (5) Strongly Agree. Items designated as reverse-coded were given the same response options. In addition to the factors of the TPB, several demographic questions were included in the survey.

### **Environmental Attitude**

Environmental attitude can be measured as a general concern for the environment. Therefore, the first factor utilized by this study was the New Ecological Paradigm (NEP) (Dunlap et al., 2000). This factor was a modification of Dunlap's 1978 factor, the New Environmental Paradigm. The New Environmental Paradigm theorized that people will react to the limits of the earth's finite resources and become more concerned with protecting them (Dunlap, 1978). Expanding upon this original idea, the New Ecological Paradigm measures ecological concern by inquiring into individual beliefs on the limits to human growth, anti-anthropocentrism, the balance of nature, the rejection of human exemptionalism, and the potential for ecocrisis. Even though the NEP has been separated into five categories, it should be utilized as a single factor evaluating overall ecological

attitude (Dunlap et al., 2000). Therefore, for the purposes of this study, the NEP was utilized as a single factor of ecological attitude. The NEP contains 15 total items, seven of which are reverse coded. Dunlap et al. (2000) reported a Cronbach's alpha of 0.83 for this factor.

### Environmental Behavior

Environmental behavior was measured in the survey as a self-reported behavior rather than an observed behavior. This item was based upon the Environmental Attitudes Inventory (EAI) developed by Milfont and Duckitt (2010) to address the multi-faceted nature of environmental attitudes; however, in this study, the multi-faceted nature of environmental attitudes was not of as much concern as the individual factors within. Therefore, of the 12 factors utilized by the EAI, only Factor 08, Personal Conservation Behavior, was utilized for this study. This factor contains ten items about personal environmental behavior to include water, electricity, and transportation, three of which are reverse coded. Milfont and Duckitt (2010) reported a Cronbach's alpha of 0.87 for this factor.

### Environmental Intention

Environmental intention was used to measure the intention of the individual to act in an environmentally friendly manner. This item was based upon the Ecological Behavior Intention (EBI) scale (Kaiser et al., 1999). The EBI evaluates the intentions of an individual to participate in specific ecological and environmentally friendly behaviors. This factor contains 11 items about ecological behavior intention to include support of environmentally friendly taxes and fees, intention to reduce vehicle usage, and support of

lower speed limits. Two items in this scale are reverse coded. Kaiser et al. (1999) report a Cronbach's alpha of 0.85 for this factor.

#### Subjective Norm

Subjective norm was measured as the perception by an individual that others around them consider a particular type of behavior to be important. This factor was developed based upon the subjective norm factor developed by Bamberg (2003) to evaluate the effectiveness of a brochure created to promote green energy products. Therefore, the wording of each item within the factor was modified to reflect reducing energy usage rather than utilizing the offered brochure from the original study. The structure of the original factor's items was maintained to ensure accuracy of results. Only two items exist in this factor, neither of which were reverse coded. The limited number of items in the original factor helped keep the overall survey for this study as short as possible. No Cronbach's alpha is reported for this factor by Bamberg (2003).

#### Perceived Behavioral Control

Perceived behavioral control is the measure of how much an individual believes they have control over a specific behavior. The factor for this study was developed based upon the perceived behavioral control factor developed by Tonglet et al. (2004). The original factor was aimed at evaluating the recycling of household waste; however, this scope was deemed too narrow for the current study. Therefore, the factor was modified slightly to replace "recycling of household waste" with "reduction of energy usage." The structure of the original factor's items was maintained as much as possible and only the subjects were switched. The factor contains seven items related to perceived behavioral

control, one of which is reverse coded. Tonglet et al. (2004) report a Cronbach's alpha of 0.88 for this factor.

### Demographics

The effect of demographic types on environmental attitudes and actions suggests the need to take demographics into account when conducting an environmental study (Zelezny et al., 2000). This study collected age, rank, gender and unit information from each participant to allow for the examination of demographic data on environmental attitudes. Age was collected in the following categories: 18-25, 26-35, 36-45, 46-55, and 56+. Gender was collected as a binary variable where 1 represented male and 2 represented female. The unit to which the individual belonged was recorded and then transformed into the intervention variable as a binary variable with 0 representing persuasive speech and 1 representing CBT module. Finally, rank was collected in the following categories: Airman, Non-Commissioned Officer, Senior Non-Commissioned Officer, Company Grade Officer, Field Grade Officer, Civilian, and Contractor.

### ***Survey Administration***

Once the survey was developed, it was created in an electronic format; an initial hyperlink was then sent to the members of each base via an email from their commander with subsequent messages coming from a designated officer. During each distribution of the survey, several follow-up emails were sent to remind members to take the survey before it expired. The questionnaire included introductory language stating that participation was voluntary, was completely anonymous, and would have no effect on the relationship of the member with their unit, their supervisor, or the United States Air Force. An example screen shot from the electronic survey is provided in Appendix B.

The initial survey was sent to the Civil Engineer Squadrons at two different bases: Base 1 and Base 2. A personally unique identifier was created by each member for the survey. In this manner, members could remain anonymous while their individual answers could be tracked over time. This also ensured that answering the survey would not jeopardize the member's future employment opportunities. The immediate post-survey and the 2-month post-survey were administered in a similar manner via hyperlinks sent in an email from the unit officers. Members taking the survey input the same unique identifier as on the initial survey for continuity of answers.

The initial survey was left open for 2 weeks prior to the intervention to maximize the number of respondents. There were 462 possible respondents from Base 1 and 376 possible respondents from Base 2. Of those, 85 members from Base 1 and 43 members from Base 2 responded to the initial survey. This resulted in an 18% and 11% response rate for the respective bases.

The intervention was applied to the respective bases immediately after the initial survey was closed. An influential speech was delivered to Base 1 at a monthly Commander's Call. Of those who attended, 84 members submitted signed commitment papers. This resulted in a commitment rate of 18%. A Computer-Based Training (CBT) was delivered to Base 2 and made available for 2 weeks to maximize the number of respondents. Since training certificates were not collected after completion of the CBT, it could not be determined how many individuals completed the intervention; however, the link to the survey was provided at the end of the CBT. Additionally subsequent emails directed that the second survey should only be taken after the CBT has been completed.



The immediate post-survey was opened as soon as the intervention concluded and was left open for 2 weeks. In the case of the CBT, the survey opened with the CBT to allow individuals to utilize the training and then immediately complete the survey. In both cases, the survey was offered as soon as possible to ensure that any immediate effects of the intervention were captured and that any changes due to external factors were reduced. Of the possible respondents from each base, 33 members from Base 1 and 32 members from Base 2 completed the immediate post-survey. This resulted in a 7% and 9% response rate for the respective bases.

The 2-month post-survey was opened exactly 2 months after the speech intervention concluded. It was left open for 2 weeks to ensure that all members who had filled out the previous surveys had the opportunity to complete the final survey in the series. Of the 462 possible respondents from Base 1 and 376 possible respondents from Base 2, 62 members from Base 1 and 35 members from Base 2 responded to the 2-month post-survey. This resulted in a 13% and 9% response rate for the respective bases.

### **Statistical Analysis**

Once all three surveys were concluded, statistical analysis was performed on the collected data to measure hypothesized versus real relationships among factors. Statistical analysis was also conducted to evaluate the change in attitudes over time. Analysis consisted of data preparation and imputation, an exploratory factor analysis, a confirmatory factor analysis, descriptive statistics of items, structural equation modeling, and paired-sample t-tests. After the full analysis, the hypotheses were also evaluated for validity.

### ***Data Preparation and Imputation***

After all of the data was collected, reverse-coded questions were prepared to reflect the intentions of the factors. The data in the SPSS file was thus re-coded into the same variable to prevent accidental use of incorrect items. After adjusting the reverse-coded questions, unusable records were identified through visual inspection and discarded. Records considered unusable included those that did not have any responses, had the same answer for all 45 survey items, or had a distinct pattern to the answers (e.g., 1, 2, 3, 4, 5, 4, 3, 2, 1...). Additionally, records in which reverse-coded items appeared similar to non-reverse-coded items were discarded. For these reasons, 362 of 654 total records were removed.

Due to a large amount of missing responses, imputed data was utilized to complete the comparison between the interventions. Data imputation is the method of substituting a value for missing data. Many methods exist for imputing data. For this study, records that were missing one or more sets of data were filled in with imputed data by replacing the missing value with the mean of the responses for that particular item. This approach was used for the exploratory factor analysis, descriptive statistics, and t-tests. For the confirmatory factor analysis and multiple-regression models, the method of maximum likelihood imputation was utilized.

### ***Exploratory Factor Analysis***

The first portion of the analysis consisted of an exploratory factor analysis (EFA). However, since the measures were developed from previously established factors, the initial EFA was used in a slightly non-traditional way. The analysis was conducted using the SPSS software package and utilizing Promax rotation with Kaiser normalization.

Items which loaded at a level of less than 0.5 on any of the factors were eliminated in an iterative manner with the weakest items being removed first. After all of the poorly loading items were removed, any items which loaded strongly on more than one factor were also removed in an iterative manner with the weakest loading items being removed first. This method was utilized to strengthen the model fit parameters of the structural equation models.

### ***Confirmatory Factor Analysis***

The next analysis performed was a confirmatory factor analysis (CFA), which was conducted only with the remaining items from the exploratory factor analysis to confirm the loadings of the items that remained. The CFA was performed with the AMOS statistical software package to determine the extent to which the measures related to each other. Due to the large number of missing data, maximum likelihood estimation was utilized. The CFA results were examined to evaluate the factor loadings and p-values for each item. Items with a poor standardized factor loadings or p-value were removed.

Once the final CFA was completed, the fit of the model was investigated. To test the absolute fit, the  $\chi^2$  test was used. To normalize the  $\chi^2$  measure, it was divided by the degrees of freedom in the default model. A value close to 1.00 is desired, but a value of 3.00 or less is considered a sign of a good fit (Carmines & McIver, 1981). The  $\chi^2$  has the disadvantage of being sensitive to sample size in that if the sample size is too small it will accept any given model (Blunch, 2008). Therefore, relative fit measures, parsimony-based fit measures, and other fit indices were evaluated to ensure the model fit under all circumstances.

Relative fit measures evaluate the interval between the saturated model, which has maximum fit, and the independence model, which has minimum fit. In this circumstance, the relative fit should be closest to the saturated model to indicate an optimal fit. The Comparative Fit Index (CFI) evaluates the relationship between the saturated model and the independence model while also accounting for degrees of freedom, thereby avoiding bias toward small sample sizes (Bentler, 1990). Generally, a value of 0.95 or higher for the CFI indicates a good fit (Blunch, 2008); however, a value above 0.90 is still acceptable in many circumstances (McDonald & Ho, 2002).

Parsimony-based fit measures discourage the use of unnecessary or excess parameters in a model (Blunch, 2008). The Parsimony Comparative Fit Index (PCFI) is a tool which takes parsimony into account for a model by normalizing the CFI. The PCFI accomplishes the normalization by multiplying the CFI by the Parsimony Ratio or the ratio of degrees of freedom between the default model and the independent model (Mulaik, et al., 1989). A value of 0.60 or higher is considered an acceptable value for the PCFI (Blunch, 2008).

Another common fit measure is the Root Mean Square Error of Approximation (RMSEA), which evaluates preciseness for the model fit based upon non-centrality assumptions (Steiger, 2000). The RMSEA is an estimate of how wrong the model is and is normalized for degrees of freedom and sample size; therefore, a value of less than 0.05 is considered a good fit and values less than 0.10 are considered acceptable (Blunch, 2008).

After confirming the model fit information, the Cronbach's alpha was calculated for each factor. Cronbach's alpha, also known as coefficient alpha, was utilized as an

estimate of the internal consistency of each factor. A Cronbach's alpha score of 0.70 or higher is desirable (Briggs & Cheek, 1986). The results of the Cronbach's alpha test were compared with the literature review results to ensure that the internal reliability of the items stayed constant or improved in the settings of this study.

### ***Descriptive Statistics***

Descriptive statistics provide quantitative features of a given data set. Such statistics help to provide a basis for evaluating the reliability and predictability of a set of items. Though there are numerous forms of descriptive statistics, this study focuses on two: skewness, and kurtosis.

Skewness is the measure of asymmetry within a probability density function. A positive skew indicates that the peak of the function is shifted to the left of normal, while a negative skew indicates that the peak of the function is shifted to the right of normal. Skewness therefore helps identify how far from normal a distribution is. Although the value of skewness is desired to be within the range of -1 to 1, values within a range of -2 to 2 are considered acceptable.

Kurtosis is a measure of the shape of a probability density function; it describes the flatness or peakedness of a curve. A positive value of kurtosis indicates that there are an infrequent number of items that are far from the mean. A negative value of kurtosis indicates that there is a large amount of deviation in the distribution. Similar to skewness, the desired range of values for kurtosis is within -1 to 1 with zero being the best; however, a range of -2 to 2 is also considered acceptable for kurtosis.

### ***Structural Equation Modeling***

Another analytical method is structural equation modeling, which was performed to evaluate the causal relationships among variables in the proposed model. The AMOS software package was utilized to build a full model with multiple time periods and evaluate the interdependencies that simple regression would not provide. The hypothesized time-lag model shown in Chapter 2 was thus evaluated to examine if the hypothesized interdependencies were supported. This analysis was conducted only between variables from both interventions over all three time periods. After the initial model was run, the weakest correlating item was removed and the analysis redone. This was done systematically until only the significant correlations remained. The evaluation of these models was conducted in two parts: from Time 1 to Time 2 with intervention regressed on Time 2 behavior and then from Time 2 to Time 3 with intervention regressed on Time 2 perceived behavioral control, attitude, and subjective norm.

### ***Paired-Sample T-Test***

Structural equation modeling was utilized to show correlations among variables, but it was unable to show change in the same factor over time; therefore, paired sample t-testing was used to evaluate if there was a change in mean over time. Several tests were conducted to evaluate the immediate change from Time 1 to Time 2, the amount of change from Time 2 to Time 3, and the overall long-term effect from Time 1 to Time 3. Missing data was imputed using the replace with mean technique when calculating the t-tests. Mean changes were only evaluated for the cognitive processes of perceived behavioral control, subjective norm, and environmental attitude. Immediate change in cognitive processes was determined by evaluating the change in mean from Time 1 to

Time 2 for both intervention types. Sustained changes in cognitive processes of environmentalism were evaluated by measuring the change in mean from Time 2 to Time

3. Finally, to determine the overall effects of the interventions on the cognitive process variables, the change in mean from Time 1 to Time 2 was evaluated.

The Bonferroni correction method was utilized to reduce likelihood of familywise error; therefore, considering 18 individual t-tests, a desired confidence level of  $p < 0.05$  was changed to  $p < 0.0028$ . For evaluation purposes, items with a confidence level of  $p < 0.0056$  were identified as corresponding with an overall  $p < 0.10$  confidence level. The results provided by the paired sample t-test were then evaluated between the two intervention types to determine if one intervention had a statistically significantly larger change than the other intervention.

### ***Hypotheses***

After the full statistical analysis was performed on the data, the data were used to evaluate the hypotheses from Chapter 2. Both the structural equation models and the paired-sample t-tests were utilized to accomplish the evaluation. Structural equation model results were utilized to evaluate hypotheses 1a, 1b, 2a, and 2b as these hypotheses dealt with causation and prediction. T-tests were utilized to evaluate hypotheses 3a, 3b, 3c, 4a, 4b, and 4c as these hypotheses dealt with change in a single factor over time.

### **Summary**

Two methods of interventions were conducted to determine their effects on changing environmental intentions and behaviors: persuasive speech and Computer-Based Training. In order to measure the respective effects of the interventions, a survey

was developed by utilizing the factors of the Theory of Planned Behavior. The items for the survey were utilized from five past studies to enhance validity. The survey was then distributed to the respective groups before, immediately after, and 2 months after the interventions to determine immediate and long-term effects of the interventions.

Statistical analysis was conducted on the survey data to determine effectiveness. The analyses conducted were an exploratory factor analysis, a confirmatory factor analysis, descriptive statistics, Cronbach's alpha, structural equation models, and paired-sample t-tests. The results of the analyses are discussed in depth in the next chapter.



## **IV. Results**

This chapter presents the results discovered from evaluating the input gathered on environmental attitudes and behaviors. The purpose of the study was to measure the environmental attitudes and behaviors of a population and evaluate the changes over time after implementation of an intervention. In order to evaluate the results, several steps were conducted. After the data was fixed and readied for evaluation, the survey items were evaluated and reduced as necessary. Next, an exploratory factor analysis was conducted and the results were interpreted. After the exploratory factor analysis, a confirmatory factor analysis was conducted on the remaining items and a Cronbach's alpha was calculated and compared with the original survey items. Once the items were confirmed and retained, the descriptive statistics for the factors were calculated to evaluate the shape of the distribution. Next, several models and tools were used to evaluate the remaining items and their correlations. Finally, the results were evaluated against the initial hypotheses to determine how the hypotheses were or were not supported by the data.

### **Preparation of Data**

The initial raw data that was submitted was not altered by the collection tool at all; therefore, several measures were taken to put the data into a useable format. First, 15 of the 45 items provided in the survey tool were reverse coded. After transforming the reverse coded items, the data was arranged by unique identifier to show longitudinal

results. However, only 11 members responded to all three surveys with the same unique identifier and an additional 51 responded to two of the three surveys with the same unique identifier. Records that were missing one or more sets of data were filled in with imputed data.

### **Initial Item Reduction**

Prior to conducting an Exploratory Factor Analysis, the items were reviewed. One item from the perceived behavioral control factor was identified for removal. The item was answered inconsistently so the item itself was reviewed. After evaluating the item, it was determined that the item, which read “reducing my energy usage is easy/a hassle,” was poorly worded. The opposing terms of “easy” and “a hassle” within the item may have lent to confusion; therefore, this item was removed from further analysis. After removal of the single item, the remaining items were deemed reliable enough for further analysis. Therefore, an exploratory factor analysis was conducted on the remaining items.

### **Exploratory Factor Analysis**

An exploratory factor analysis was conducted on all 44 items presented from the survey. Promax rotation was utilized for this analysis to allow cross-loading. By allowing cross-loading of items, items which showed heavy cross-loadings were eliminated to strengthen the reliability of the five factors. Upon initial observation, it became necessary to remove all of the reverse coded items as the reverse coded items did not match up effectively with the remaining items. Since there were 15 reverse-coded items, the total number of items was reduced from 45 to 30. An exploratory factor

analysis was conducted with the remaining items and a scree plot was generated. Although eight factors were presented in the initial EFA, the scree plot showed an inflection point between the fourth and fifth items, indicating that a four factor model would be appropriate after removal of poorly loading items. This was in contrast to the desire to have five factors. The scree plot is shown in Appendix C and the initial exploratory factor analysis factor loadings are shown in Appendix D.

The remaining analysis was limited to items with factor loadings greater than 0.5 and with minimal cross-loading. Additionally, items which loaded strongly against multiple factors were removed to ensure a proper five factor model. Of the 30 items evaluated, 10 were removed for the aforementioned reasons leaving 20 items as valid, reliable items. The final analysis showed five factors with items that corresponded correctly to the factors desired: perceived behavioral control, subjective norm, environmental attitude, intention, and behavior. Though the scree plot had only shown four factors, this could be explained by the subjective norm factor which loaded very low. The final exploratory factor analysis factor loadings are shown in Appendix E. The remaining 20 items were then evaluated with a confirmatory factor analysis to further test the fit of the items within each factor.

### **Confirmatory Factor Analysis**

A confirmatory factor analysis was conducted on the same data set utilizing maximum likelihood estimation. This was done to further confirm the reliability of the factors. The initial CFA had good  $\chi^2/\text{df}$ , PCFI, and RMSEA fits (2.004, 0.66, and 0.068, respectively); however, the CFI was poor (0.866). Three items showed low standardized

factor loadings or high p-values. Although these items loaded against the proper factor in the EFA, the low factor loadings in the CFA indicated the items could still have a negative effect on the model; therefore, they were removed from further analysis, bringing the final total number of items to 17.

A final confirmatory factor analysis was conducted with the remaining 17 items. By removing the three items, the CFA provided better model fit parameters for the  $\chi^2/df$ , PCFI, RMSEA, and CFI tests (1.837, 0.649, 0.062, and 0.911, respectively). The final CFA parameters all fall within the recommendations provided by Blunch (2008); therefore, the model was deemed a good fit and the items and factors were considered usable for further analysis. A summary of the confirmatory factor analysis results is shown in Table 2 and the full results are shown in Appendix F.

Table 2: Confirmatory Factor Analysis Model Fit Summary

Model	$\chi^2$	$\chi^2/df$	CFI	PCFI	RMSEA
Initial CFA	320.658	2.004	0.866	0.66	0.068
Final CFA	200.231	1.837	0.911	0.649	0.062

### ***Cronbach's Alpha***

After the CFA was completed and the model fit data was collected, Cronbach's alpha was determined for the five factors. These calculations were performed only on the remaining items and then compared with literature. The results of the coefficient alpha tests are summarized in Table 4.

Table 3: Summary of Cronbach's Alpha for Factors

Scale	N	No. of Items	Cronbach's Alpha	
			Study	Literature
<b>Attitude</b>	217	6	0.878	0.83
<b>Subjective Norm</b>	217	2	0.573	N/A
<b>Intention</b>	217	3	0.873	0.85
<b>Behavior</b>	216	3	0.900	.80, .75, .87
<b>PBC</b>	215	3	0.764	0.88

The attitude factor was based upon the New Ecological Paradigm (NEP) (Dunlap, 2000). The original factor contained 15 items about the respondent's attitude toward the environment while the factor evaluated in this study was reduced to only 6 items. The resulting Cronbach's alpha was determined to be 0.878, which was better than the 0.83 Dunlap (2000) reported.

The subjective norm factor (Bamberg (2003) was modified slightly to reflect energy reduction. The original factor contained 2 items and both were kept for the analysis of this study. Bamberg (2003) did not report a Cronbach's alpha for the factor, but this study reported a coefficient alpha of 0.573 which was lower than the necessary 0.70; however, since this factor only contained two items, the Cronbach's alpha could not be improved by removing an item. The two items were kept despite the low Cronbach's alpha score.

The environmental intention factor, developed by Kaiser et al. (1999), originally contained 11 items about the respondent's intention to act in an environmentally friendly manner. Eight of the items were removed in the EFA and CFA so only the three

remaining items were evaluated in this study. The Cronbach's alpha for this factor was 0.873, which was slightly higher than the 0.85 reported by Kaiser et al. (1999). The value was also significantly higher than the minimum 0.70, so the reliability of this factor was confirmed.

The environmental behavior factor was developed from the environmental attitudes inventory by Milfont & Duckitt (2010). The original factor contained 10 items pertaining to the respondent's actual environmental behavior. Seven of the items were removed in the EFA and CFA so this study only utilized the three remaining items for analysis. The Cronbach's alpha in this study was determined to be 0.900, which is higher than the highest reported value of 0.87 by Milfont & Duckitt (2010). These values are also higher than the minimum of 0.70 which confirmed the reliability of the factor.

The perceived behavioral control factor was developed by Tonglet et al. (2004). The original factor contained seven items about the respondent's feeling of control over environmental behaviors. Four items were removed in the EFA and CFA leaving only three items for analysis. The Cronbach's alpha in this study was determined to be 0.764, which is lower than the reported 0.88 (Tonglet et al., 2004). Although this value is significantly lower than the reported value, it is still higher than the minimum 0.70 and was therefore validated.

### **Descriptive Statistics**

After the Confirmatory Factor Analysis was completed, descriptive statistics were determined for the remaining items as shown in Table 3. In this study, each of the five factors had a slightly negative skew indicating that the responses were not normally

distributed. Attitude, subjective norm, intention, and perceived behavioral control all contained skewness values greater than -1 and less than 1 (-0.585, -0.487, -0.149 and -0.438, respectively). The behavior factor had a skewness of -1.450, indicating that it was further negatively skewed but was still within an acceptable range; therefore, all of the factors contained acceptable skewness scores.

Attitude, subjective norm, and perceived behavioral control all contained kurtosis values greater than -1 and less than 1 (0.01, 0.596 and -0.098, respectively). Intention and behavior had a kurtosis value of -1.017 and 2.443, respectively. The intention value was within the acceptable range of -2 to 2, but the behavior value was outside of the acceptable range. The high positive kurtosis value of 2.443 indicated that a large number of respondents answered the behavior items similarly with few deviations. When combined with the skewness data, it showed that a large number of respondents answered higher than a 3 and that there were few deviations from that high answer.

Table 4: Summary of Descriptive Statistics

Scale	N	No. of Items	M	SD	Skewness	Kurtosis
<b>Attitude</b>	217	6	3.5538	.90655	-.585	.010
<b>SN</b>	217	2	3.5219	.83175	-.487	.596
<b>Intention</b>	217	3	3.0489	1.22126	-.149	-1.017
<b>Behavior</b>	216	3	4.2181	.80850	-1.450	2.443
<b>PBC</b>	215	3	3.5713	.88900	-.438	-.098

### Structural Equation Models

Two models were utilized to evaluate the hypotheses from Chapter 2. The first model evaluated was the Theory of Planned Behavior with intervention regressed on Time 2 behavior. The second model evaluated the relationships of the TPB from Time 2 to Time 3 with intervention regressed on perceived behavioral control, subjective norm, and attitude.

#### *Model 1*

The proposed model was evaluated first for fit, and then for statistically significant correlations. Model fit for Model 1 was relatively weak with a low CFI of 0.880; however, the model exhibited a relatively low, though acceptable, PCFI (0.662) and acceptable values for  $\chi^2/\text{df}$  (1.986) and RMSEA (0.068). Therefore, the model was utilized to evaluate the relationships it posited. A diagram of model 1 with only the significant paths is shown in Figure 8. The Coefficient of Determination is annotated for each factor in parentheses. Of note, this model shows a direct link from subjective norm through attitude and intention to behavior in Time 2. This finding reinforces the social norms theory and provides a basis for affecting behavior through the subjective norm



factor. This model also indicates that perceived behavioral control was affected by subjective norm, but then was then unable to affect any other aspect of the TPB model.

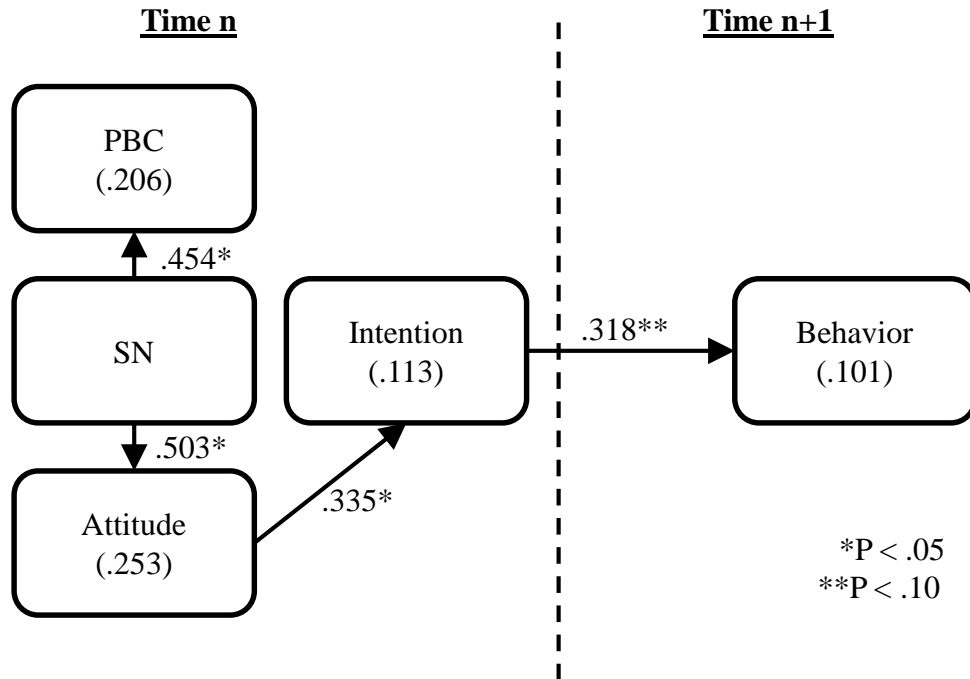


Figure 8: Correlations of Model 1 from Time 1 to Time 2

### ***Model 2***

Similar to Model 1, Model 2 was evaluated for fit and then for statistically significant correlations. The fit for Model 2 was relatively weak with a low CFI (0.830), but had other good model fit indicators such as PCFI (.631),  $\chi^2/df$  (1.899), and RMSEA (0.065); therefore, this model was utilized to evaluate the relationships of the TPB from Time 2 to Time 3. A diagram of Model 2 with only the significant paths is shown in Figure 9. The Coefficient of Determination is annotated for each factor in parentheses.

Arguably the most important discovery was the correlation between intervention and subjective norm, albeit weak, with a p-value of less than 0.10 ( $r = .234$ ,  $p = .075$ ). This indicates that the persuasive speech was more influential on subjective norm than the Computer-Based Training, and that the influence was able to propagate through to behavior in Time 3 based upon the same path being confirmed in Model 1. Though the Coefficient of Determination for subjective norm was rather low, the correlation between intervention and subjective norm indicates that one intervention had more of an effect on subjective norm than the other. This link will be discussed in more detail later in this chapter. The lack of consistency in the correlation between subjective norm and perceived behavioral control indicates that their link is tentative.

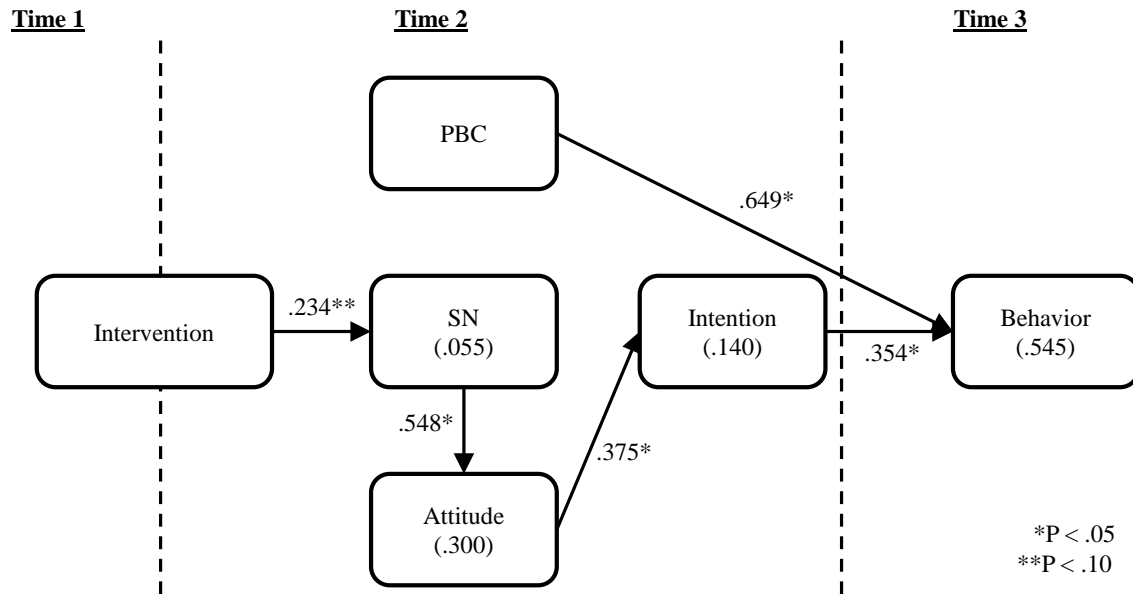


Figure 9: Correlations of Model 2 from Time 2 to Time 3

## T-Tests

Table 5 shows a summary of the t-test results. Full t-test analysis results are shown in Appendix G. Tests were conducted from Time 1 to Time 2, Time 2 to Time 3, and Time 1 to Time 3, the results of which are discussed below.

Table 5: T-Test Results for Cognitive Process Variables

<b>Persuasive Speech</b>						
	<b>Time 1 – 2</b>		<b>Time 2 – 3</b>		<b>Time 1 – 3</b>	
<b>Factor</b>	<b>Change</b>	<b>P-Value</b>	<b>Change</b>	<b>P-Value</b>	<b>Change</b>	<b>P-Value</b>
<b>Attitude</b>	0.1751	0.012	-0.1049	0.113	0.0702	0.358
<b>SN</b>	0.3613	.000**	-0.2286	.000**	0.1327	0.088
<b>PBC</b>	-0.21	.000**	0.1085	0.021	-0.1015	0.08
<b>Computer-Based Training</b>						
	<b>Time 1 – 2</b>		<b>Time 2 – 3</b>		<b>Time 1 – 3</b>	
<b>Factor</b>	<b>Change</b>	<b>P-Value</b>	<b>Change</b>	<b>P-Value</b>	<b>Change</b>	<b>P-Value</b>
<b>Attitude</b>	0.1356	0.107	-0.0973	0.189	0.0383	0.599
<b>SN</b>	-0.0946	0.211	-0.1014	0.135	-0.196	.004*
<b>PBC</b>	-0.0067	0.917	0.062	0.318	0.0553	0.432

\* p &lt; .0056

\*\*p &lt; .0028

*Time 1 versus Time 2*

Subjective norm and perceived behavioral control both had a significant change within this time period for the persuasive speech while none of the cognitive processes had a significant change for the CBT. Participants showed an increase of 0.3613 in subjective norm on a 5-point Likert-type instrument from Time 1 to Time 2, and a drop of 0.21 in perceived behavioral control. This appears to indicate that the persuasive speech provided an initial awareness to the attendees that their peers and community found the environment important, but reduced their perception that they could do anything to help the environment. The increase in subjective norm was also important as the Structural Equation Model showed a direct connection between subjective norm and

long-term behavior. The Computer-Based Training intervention was unable to effect any significant immediate change.

### ***Time 2 versus Time 3***

For this time period, only one significant change was detected. Participants showed a drop in subjective norm of 0.2286 on a 5-point Likert-type instrument from Time 2 to Time 3 for the persuasive speech intervention. This seems to indicate that, despite short-term gains from Time 1 to Time 2, the persuasive speech was not able to prolong an individual's awareness regarding the importance of environmental issues to importance to others. The CBT intervention once again had no significant changes in the means of the cognitive process variables.

### ***Time 1 versus Time 3***

None of the variables showed a significant change at the  $p < 0.05$  level after Bonferroni correction; however, participants showed a 0.1960 decrease in subjective norm for the CBT intervention at the  $p < 0.10$  level after Bonferroni correction. The steady decrease in subjective norm for the CBT intervention indicates that the CBT may have been unsuccessful at promoting awareness regarding environmental importance to others and instead may have prompted individuals to believe that environmentalism was not as important to their peers and community as the individuals originally may have believed. This was important to note as the Structural Equation Model showed a direct link between subjective norm and long-term behavior. The lack of any significant changes from Time 1 to Time 3 indicates that neither intervention was effective at creating long-term changes in environmental cognitive processes.

## **Hypothesis Results**

Hypothesis 1a, which suggested that past cognitive processes of environmentalism would cause environmentally friendly behaviors in the future, was found to be partially supported. The results from the structural equation model showed that intention in one time period was a consistent predictor of behavior in the following time period; however, perceived behavioral control in one time period was not a consistent predictor of behavior in the next time period. Additionally, attitude was the only cognitive process of environmentalism that predicted environmental intention. Hypothesis 1a was partially supported due to these findings.

Hypothesis 1b posited that the intervention would have no effect on Time 2 behavior. This hypothesis was supported by the structural equation model which showed no correlation between intervention and Time 2 behavior. This finding indicates that intervention does not immediately affect behavior and also confirms hypothesis 1a that prior cognitive processes of environmentalism are the only predictors of future behavior. Hypothesis 1b was not supported.

Hypothesis 2a suggested that subjective norm would cause perceived behavioral control of environmentally friendly actions. This hypothesis was not supported as it was supported in Time 1, but not in Time 2. These findings indicate that subjective norm was not a consistent predictor of perceived behavioral control. Therefore, hypothesis 2a was not supported.

Hypothesis 2b was similar to hypothesis 2a as it suggested that subjective norm would cause individual pro-environmental attitudes. This hypothesis was supported through the structural equation model which showed that subjective norm was a

consistent predictor of environmental attitude. Confirmation of social norms theory as applied to environmentalism indicates that individual attitudes may be changed by demonstrating strong public concern for the environment. Hypothesis 2b was supported.

Hypothesis 3a posited that the persuasive speech would have the same effect on perceived behavioral control as a short, informational CBT. This hypothesis was not supported as the t-tests showed that individuals who were subjected to the persuasive speech reduced their feelings of control over environmentally friendly behaviors. This could be due to an enlarged scope of what is necessary to act in an environmentally friendly behavior. The persuasive speech may have convinced individuals that there was more to do than what he or she was already doing and this may have reduced the individual's perceived control over the environment. This phenomenon should be addressed in future research as perceived behavioral control was shown to potentially have an effect on environmentally friendly behavior. Hypothesis 3a was not supported.

Hypothesis 3b suggested that the persuasive speech intervention would increase an individual's subjective norm more than a short, informational CBT. This hypothesis was supported by both the structural equation model and the t-tests. The structural equation model indicated that intervention type predicts subjective norm, and the t-tests showed that the persuasive speech affected a much larger, positive, statistically significant change in subjective norm than the CBT. As hypothesis 2b indicated, subjective norm had a strong effect on environmental attitudes, and hypothesis 1a indicated that attitude had a consistent effect on intention which consistently affected behavior in a later time period. By this reasoning, hypothesis 3b indicates that the

persuasive speech was more effective at changing long-term behavior by affecting subjective norm, attitude, and then intention. Hypothesis 3b was supported.

Hypothesis 3c posited that the persuasive speech would increase environmental attitudes more than a short, informational CBT. This hypothesis was not supported as the structural equation model showed that intervention did not cause attitudes. Additionally, t-tests showed that, though not statistically significant, the persuasive speech intervention slightly raised environmental attitudes at nearly the same rate as the CBT. This indicates that neither intervention was successful at strongly affecting environmental attitudes, but the slight change that was caused was the same for both interventions. Hypothesis 3c was not supported.

Hypothesis 4a posited that any changes in perceived behavioral control of environmentally friendly actions would fade over time. This hypothesis was supported as the changes caused in perceived behavioral control by the persuasive speech were reduced to an insignificant level over time. This reversion of change of perceived behavioral control over time indicates that the persuasive speech was only successful at affecting short-term change rather than long-term change. Hypothesis 4a was supported.

Hypothesis 4b suggested that changes in subjective norm would fade over time. This hypothesis was partially confirmed through t-tests. The persuasive speech was highly successful at increasing subjective norm, but t-tests show that those changes were reduced to an insignificant level over time indicating that the persuasive speech intervention was only effective in the short-term. The CBT intervention caused no significant short-term gains; however, the culmination of short-term changes caused a long-term decrease in subjective norm at a partially significant level. This continual



decline in subjective norm indicates that the CBT caused respondents to feel as though their peers and community did not care about the environment as much as he or she had originally thought. Since the structural equation model showed a link from subjective norm to behavior, this long-term decrease could potentially decrease environmentally friendly behaviors in later time periods causing the opposite effect than desired.

Hypothesis 4b was supported.

Hypothesis 4c suggested that changes in individual environmental attitudes would fade over time. This hypothesis was supported with t-tests. Although no significant changes were detected in environmental attitudes, a slight initial increase and then long-term decrease was observed in attitude for both interventions. This fade in attitudes over time indicates that neither intervention was an effective tool at directly changing attitudes over the short or long-term. Hypothesis 4c was supported.

## **Summary**

This chapter provided the results of the analysis, which indicated that persuasive speech was effective at changing an individual's perception of what others think of the environment. This subjective norm was then indicated to affect an individual's personal environmental attitudes which then affected his or her environmental intention.

Individual environmental intention was then shown to affect environmentally friendly behavior in the next time period. This indicates that the persuasive speech was more effective at affecting long-term behaviors than the CBT intervention; however, the persuasive speech had a negative initial effect on perceived behavioral control of environmentally friendly activities. As perceived behavioral control was shown to have

an inconsistent effect on behavior in a later time period, this negative effect could potentially negatively affect environmentally friendly behaviors. It was important to look at ways that the persuasive speech could be enhanced to either stabilize or increase perceived behavioral control in future applications.

Additionally, the CBT intervention was shown to have no significant effects in any time period. This indicates that, when attempting to change environmental values, a CBT may not be worth instituting. These results can help save the time and money associated with creating a CBT that will likely have little results on environmentalism. The following chapter provides a further discussion of the results.

## **V. Conclusions**

The purpose of this study was to evaluate the effects of two different interventions as they related to environmental attitudes and behavior. Data were collected through an online survey administered to two separate but similar organizations and analyzed to determine correlations and statistically significant changes over time. This chapter provides a discussion of the results presented in the previous chapter, the implications of those results, limitations to the research, and areas of potential future research.

### **Discussion**

The first question addressed in this research was that of being able to predict environmentally friendly behaviors using the cognitive processes of the Theory of Planned Behavior. The structural equation models indicated that positive environmental attitudes consistently predicted positive environmental intentions. In turn, environmental intentions were found to predict pro-environmental behavior. The other cognitive processes were not found to consistently predict intention or behavior. These results indicate that changing an individual's environmental attitude can yield a change in their pro-environmental behavior. This is important to note as it indicates that a properly developed intervention which is directed at changing environmental attitudes can also potentially cause changes in environmental behavior.

The cognitive processes were also evaluated to determine if they could predict each other. Specifically, relying on social norms theory, subjective norm was examined

for predictability of perceived behavioral control and environmental attitude. Through structural equation modeling, subjective norm was found to only occasionally predict perceived behavioral control and perceived behavioral control only occasionally predicted behavior; so for the purposes of this study, the link between subjective norm and perceived behavioral control was discounted. Subjective norm was found to consistently predict attitude which reinforced social norms theory. This indicates that one could artificially alter an individual's attitude by modifying his or her view of others. The implication of this finding is that if an organization can portray the social norm as one of pro-environmental activity, it may be able to increase an individual's attitude toward the environment.

If social norm and attitude are capable of affecting behavior, then it is important to evaluate the effects different intervention types may have on social norm and attitude. If an intervention is capable of producing significant changes in social norm or attitude, it may also be successful in changing behavior. This study evaluated two different interventions: persuasive speech and a computer-based training module (CBT). This was accomplished with structural equation modeling with an intervention variable. Results indicate that the persuasive speech was more useful for changing subjective norm than the computer-based training module. This means that the persuasive speech did a better job of persuading individuals that environmentally friendly behavior was the social norm than did the computer-based training module. This is important when used in conjunction with the previous findings which indicated that subjective norm has an indirect influence on pro-environmental behavior. However, this study indicated that the persuasive speech had no strong effects on attitude directly or perceived behavioral

control. Additionally, using t-tests, the computer-based training module was found to have no significant effect on any of the cognitive processes. This indicates that the CBT utilized in this study was unsuccessful at creating change with relation to environmental behavior. This finding could imply that a CBT is unable to create change or that the CBT utilized in this study was poorly constructed.

This study evaluated cognitive processes of environmentalism over a 2-month period to assess the capability of providing sustained change. The results of the study showed that participants who received the persuasive speech intervention had an initial spike in subjective norm, but then after 2 months that spike faded to a non-significant change. This suggests that the intervention provided no significant change over the long-term in any of the cognitive processes and was therefore unsuccessful. In contrast to the persuasive speech, the CBT was shown to have a significant decrease in subjective norm over a 2-month period. This decrease in subjective norm indicates that the CBT was unsuccessful at convincing participants that their peers were as concerned about the environment as they may have originally believed.

When combining these findings, it appears that the persuasive speech intervention was successful at creating a near immediate change in subjective norm which, in turn, created a change in behavior several months later. Subjective norm was shown to decrease over time, which indicates that any beneficial changes in behavior would likely fade as well; however, if a short-term environmental goal were desired, this study indicates that it could be achieved through a persuasive speech. This finding is in contrast to the CBT which appeared to produce little to no effect on environmental cognitive processes in the short or long-term.

## **Implications**

The results of this research have many implications for interventions. For example, the results indicated that attitude and subjective norm were both indirect predictors of behavior. Similarly, perceived behavioral control was shown to have intermittent predictive properties on behavior. The implications of this finding can be useful to the creation of future interventions. Although the interventions from this study did not have a strong effect on the cognitive processes of environmentalism, future interventions could be designed to specifically target subjective norm and attitude parameters which could enable them to yield larger changes in behavior. Future interventions could reduce the effort to target perceived behavioral control and focus upon persuading participants that environmentalism is something their peers are interested in. Targeted interventions could produce more desirable results which may enhance their effects.

The persuasive speech was administered in-person to a live audience whereas the CBT was administered on a computer. The information in each intervention was designed to be as similar as possible. The results of this study showed that, in the short-term, the persuasive speech had more of an effect on subjective norm which could then be tracked through to long-term behavior. This indicates that information designed to influence environmental behavior was better received and internalized when presented in-person than an impersonal manner such as a computer. Although this cannot necessarily be extrapolated to CBTs in general, it indicates that environmental concerns may be better implemented in public from a personal source to create more desired effects.

The interventions in this study were intended to provide long-term changes in environmental attitudes and behaviors. Results showed that changes created by the persuasive speech were not sustained over a 2-month period which indicates that the speech would not be a good tool for affecting long-term change; however, the persuasive speech was successful at creating short-term changes. This suggests that if an organization wished to create changes in behaviors to achieve a short-term environmental goal, the persuasive speech may be a plausible solution. Conversely, this study also suggests that the use of a CBT to change environmental attitudes and behaviors may not be desirable.

### **Limitations**

An initial limitation of this study was that it only utilized Air Force personnel from the civil engineer career field. Although the demographics of the military tend to reflect that of the general population, there may still be an issue with generalizing results to the private sector. Therefore, the demographics of the units utilized in this study should be considered when generalizing the results.

A second limitation of this study was that the response rates were quite low. Additionally, of the responses that were provided, many records had missing data. Due to the low response rates and missing data, the power of the study was lessened. This provides the possibility that other changes were present, but the power was not strong enough to detect them.

Another limitation of the study was that only self-reported data were collected. This limitation was seen foremost in the context of pro-environmental behavior.

Individual users may over-estimate their pro-environmental behavior, especially once the social norm was affected. The survey did not contain questions that would test for truthfulness so it was assumed that self-reported behavior was an accurate representation of actual behavior.

A fourth limitation of the study was that little controls were provided for external factors. Attitudes and behaviors can be influenced by external factors such as current events or organizational programs. This study requested that the units not perform other environmental programs during the period of study, but other factors outside of the unit were not controlled for. This allows for the possibility that changes were due to external factors and not the interventions.

A fifth limitation of this study was the reliability of the subjective norm items. Although these items were used from previously validated studies, their subjects were changed to serve this study. Additionally, the Cronbach's alpha for the subjective norm factor was quite low. This limited the reliability of the results and therefore limited the applicability of the findings.

Similar to the internal validity of the items, a final limitation of the study was the model fit for the structural equation models. Although the majority of the model fit indicators were in acceptable ranges, the Comparative Fit Index was low for both models. This restricted the applicability of the results from the structural equation models. This study performed t-tests to further validate the results which lent credence to the results provided by the structural equation models.



## **Future Research**

Future research needs to be conducted to evaluate enhanced interventions. Based upon the results of this study, an intervention should be developed to include elements of persuasion designed to target subjective norm and attitude. An intervention of this type could be utilized to target more specific, desired environmental behaviors.

Additionally, the sample population should be expanded in future research. This study utilized a relatively small sample size from two units with similar demographics and geographic locations. Expanding this study to other regions and including a wider array of demographics may provide further insight into the effects created by the interventions. This type of research could help indicate whether certain interventions would be more beneficial to a specific region or demographic. Additionally, increasing the sample size of the study could provide a stronger validity and reliability of results.

Another area of future research could be the application of similar intervention programs in other subjects. This study evaluated the effects of two interventions on environmental attitudes and behaviors, but those interventions may also have effects on other types of attitudes and behaviors. As the Air Force and other organizations are utilizing more and more computer-based training modules, it could be important to see if those modules have any significant effects.

Finally, although research suggested that demographic data could affect environmental attitudes and behaviors, this study did not analyze that aspect. Future research could focus on the differences among demographic populations with respect to environmental attitudes and behaviors. This research could prove useful in developing a more targeted intervention which may have more significant and sustained results.

## **Conclusion**

In addition to federal mandates which require federal entities to drastically reduce resource usage, commercial enterprises are beginning to evaluate methods of reducing resource consumption to reduce costs and become more ecologically friendly. Although politicians and organizational leaders are beginning to promote public environmental policies and procedures, the individuals who carry out the policies may be the reason the policies succeed or fail; therefore, it is important to determine ways to change environmental attitudes and behaviors to ensure individuals do their part to support the policies.

In this study, two commonly utilized interventions were evaluated to determine their respective effects on environmental attitudes and behaviors. This study indicated that short-term environmentally friendly behaviors can be affected by a persuasive speech designed to target an individual's subjective norm. Additionally, this study indicated that a computer-based training module was unable to create any kind of change in environmental attitudes or behaviors in either the short or long-term.

The results of this study are important to organizations who wish to perform interventions to create attitudinal and behavioral change with respect to the environment. Neither intervention was successful at creating long-term effects. This indicates that computer-based training modules or persuasive speeches should not be utilized if trying to create organizational change. The effects of the CBT in this study were minimal; this indicates that the computer-based training module would not be a beneficial investment for an organization. Conversely, the persuasive speech in this study was shown to encourage environmentally friendly behavior, albeit on a very short-term basis. This

indicates that an organization wishing to achieve a short-term goal for resource reduction may find a persuasive speech to be a beneficial investment. Additionally, this study indicates that the persuasive speech could be altered to more strongly affect subjective norm, thereby creating a stronger increase in environmentally friendly behavior, although future research needs to be conducted to confirm this.

This study provides organizations a way forward in attempting to achieve short-term changes in environmentally friendly behaviors. Additionally, this study indicates ways in which an organization can avoid excess cost and effort on interventions that are not likely to create change. Although computer-based training modules are becoming more widespread in their use, it appears that their effects are nearly inconsequential when dealing with environmentalism. This study indicates that a persuasive speech may be the preferable course of action for an organization wishing to create short-term environmentally friendly change.

## **Appendix A: Survey Items**

### **Demographics:**

Below are demographic questions about you. Please indicate which category best applies to you by clicking on the appropriate response. Remember that your information will be kept confidential.

- 1) Age (18-25, 26-35, 36-45, 46-55, 56+)
- 2) Gender (Male, Female)
- 3) Unit (60 CES, 9 CES)
- 4) Rank (Amn, NCO, SNCO, CGO, FGO, Civilian, Contractor)

### **Attitude (adopted from Dunlap et al., 2000):**

Listed below are statements about the relationship between humans and the environment. Using the scale provided, indicate the extent to which you agree with each statement by clicking on the appropriate response.

- 1) \*Humans have the right to modify the natural environment to suit their needs
- 2) \*Human ingenuity will ensure that we do NOT make the earth unlivable
- 3) \*The earth has plenty of natural resources if we just learn how to develop them
- 4) \*The so-called "ecological crisis" facing humankind has been greatly exaggerated
- 5) \*The balance of nature is strong enough to cope with the impacts of modern industrial nations
- 6) \*Humans were meant to rule over the rest of nature
- 7) \*Humans will eventually learn enough about how nature works to be able to control it
- 8) We are approaching the limit of the number of people the earth can support
- 9) When humans interfere with nature it often produces disastrous consequences
- 10) Humans are severely abusing the environment
- 11) Plants and animals have as much right as humans to live
- 12) Despite our special abilities, humans are still subject to the laws of nature
- 13) The earth is like a spaceship with very limited room and resources
- 14) The balance of nature is very delicate and easily upset
- 15) If things continue on their present course, we will soon experience a major ecological catastrophe

**Subjective Norm (adapted from Bamberg, 2003):**

Below are questions related to your view of others' opinions. Indicate the extent to which you agree with each of the statements provided by clicking on the appropriate response.

- 16) Most people who are important to me would support my reducing energy usage within the next few months
- 17) Most people who are important to me think that I should reduce energy usage within the next few months

**Intention (adopted from Kaiser et al., 1999):**

Below are questions related to your intention to participate in certain behaviors. Indicate the extent to which you agree with each of the statements provided by clicking on the appropriate response.

- 18) \*I will still need my automobile in the future
- 19) \*I will travel by automobile or by airplane during my vacations
- 20) I support raising parking fees in cities
- 21) I am ready to pay environmental taxes (e.g. raising fuel or automobile taxes)
- 22) I support speed limits on freeways (62.5 mph and 45 mph where freeways cross residential areas)
- 23) I support efforts to create automobile-free inner cities
- 24) I would prefer to drive only if absolutely necessary (i.e. no other mode of transportation is available)
- 25) I would prefer not to drive to work any longer
- 26) I would prefer to be able to go shopping without my automobile
- 27) I will stop the engine at red lights in the future
- 28) My next automobile will be small and as ecologically sound as possible

**Behavior (adopted from Milfont and Duckitt, 2010):**

Below are questions related to your actual performance of specific actions. Indicate the extent to which you agree with each of the statements provided in regard to how often you actually perform these actions by clicking on the appropriate response.

- 29) \*I could not be bothered to save water or other natural resources
- 30) \*In my daily life I'm just not interested in trying to conserve water and/or power
- 31) \*I drive whenever it suits me, even if it does pollute the atmosphere
- 32) \*I am NOT the kind of person who makes efforts to conserve natural resources
- 33) \*Even if public transportation was efficient than it is, I would prefer to drive my own car
- 34) I make sure that during the winter the heating system in my room is not switched on too high
- 35) Whenever possible, I take a short shower in order to conserve water
- 36) I always switch the light off when I don't need it on any more
- 37) In my daily life I try to find ways to conserve water or power
- 38) Whenever possible, I try to save natural resources


**Perceived Behavioral Control (adopted from Tonglet, 2004):**

Below are questions related to how much control you believe you have over certain behaviors. Indicate the extent to which you agree with each of the statements provided by clicking on the appropriate response.

- 39) \*Reducing my energy usage is inconvenient.
- 40) I have plenty of opportunities to reduce my energy usage.
- 41) Reducing my energy usage is easy/a hassle.
- 42) My unit provides satisfactory resources to reduce my energy usage.
- 43) I know what methods can reduce my energy usage.
- 44) I know where to go for help with reducing my energy usage.
- 45) I know how to reduce my energy usage.

\*Indicates reverse coded item

## Appendix B: Computer Survey Screen Shots



# Environmental Behavior Survey

AN AIR FORCE INSTITUTE OF TECHNOLOGY SURVEY

**Survey meets criteria for exclusion for a SCN under 32 CFR 219, DoDD 3216.2, and AFI 40-402**

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### Privacy Notice

The following information is provided as required by the Privacy Act of 1974:

**Purpose:** The United States Air Force searches continually for means and methods to conserve materials and costs associated with our mission. A large portion of this cost can be attributed to environmental and ecological costs of energy use and excess use of resources. However, parts of these costs can be avoided by developing an understanding of attitudes and behaviors of Air Force members such as you. This survey is part of a research study that will ask you about your attitudes towards the environment, your behaviors as they pertain to the environment, and you thoughts on some additional subjects. Your Commander has authorized the implementation of this survey. Your Commander has also approved you to take this survey if you desire. All answers to these questions are anonymous and therefore cannot be traced back to you. The user identification you are asked to create will not be used to trace who you are, but instead to track similar answers over time. DO NOT distribute this survey outside of your unit.

**Participation:** Your participation in this data collection is greatly appreciated and desired. Though your participation will be extremely helpful to this research, please remember that it is **COMPLETELY VOLUNTARY**. Whether you decide to participate or withdraw from the survey will have no impact upon your relationship with your unit, the United States Air Force, or the Department of Defense.

**Confidentiality:** Demographic information will be requested for the sole purpose of interpreting the data more specifically. Remember that **ALL ANSWERS ARE ANONYMOUS** and that no one other than the researchers will see the answers provided.

---

**Unique ID**

This ID is required to complete this survey. This ID in no way identifies you, but will enable us to track responses ANONYMOUSLY.

First Letter of your mother's maiden name	Last Letter of your father's first name	First Number of your day of birth	First number of your birth month	Last number of your birth year
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

---

### Instructions

- Base all of your responses on your own personal experiences, thoughts, or desires
- If providing a response to the survey, please make your answers as clear and concise as possible
- There is no "right" answer. Be sure to select the option that you feel is correct when asked

---

### Contact information:

If you have any questions, comments, or concerns about this survey, please contact **Capt. Jeremy Kinne** using the information below.

AFIT/ENV BLDG 640/Room 104A  
2950 Hobson Way  
Wright Patterson AFB OH 45433-7765  
Email: [Jeremy.kinne@afit.edu](mailto:Jeremy.kinne@afit.edu)  
Advisor: [Alfred.thal@afit.edu](mailto:Alfred.thal@afit.edu)  
Phone: DSN 85-3636 x7401, commercial (937) 255-3636 x7401  
Fax: DSN 986-4699, commercial (937) 656-4699

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Start Survey

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**NOTICE & CONSENT BANNER:**  
*Use of this DoD computer system, authorized or unauthorized, constitutes consent to monitoring of this system. Unauthorized use may subject you to criminal prosecution. Evidence of unauthorized use collected during monitoring may be used for administrative, criminal, or other adverse action. Use of this system constitutes consent to monitoring for these purposes.*

Read the [Privacy and Security Notice](#)



# Environmental Behavior Survey

AN AIR FORCE INSTITUTE OF TECHNOLOGY SURVEY

## Section I:

### Demographic Information

Below are demographic questions about you. Please indicate which category best applies to you by clicking on the appropriate response. Remember that your information will be kept confidential.

	18-25	26-35	36-45	46-55	56+
	1	2	3	4	5
1. Age	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	Male	Female
	1	2
2. Gender	<input type="radio"/>	<input type="radio"/>

	9 CES
	1
3. Unit	<input type="radio"/>

	Amn	NCU	SNCO	CGO	HGO	Civilian	Contractor
	1	2	3	4	5	6	7
4. Rank	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

CONTINUE





# Environmental Behavior Survey

AN AIR FORCE INSTITUTE OF TECHNOLOGY SURVEY

## Section II:

Listed below are statements about the relationship between humans and the environment. Using the scale provided, indicate the extent to which you agree with each statement by clicking on the appropriate response.

Attitude:		Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
		1	2	3	4	5
1	Humans have the right to modify the natural environment to suit their needs	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	Human ingenuity will ensure that we do NOT make the Earth unlivable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	The Earth has plenty of natural resources if we just learn how to develop them	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4	The so-called "ecological crisis" facing humankind has been greatly exaggerated	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5	The balance of nature is strong enough to cope with the impacts of modern industrial nations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6	Humans were meant to rule over the rest of nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7	Humans will eventually learn enough about how nature works to be able to control it	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8	We are approaching the limit of the number of people the Earth can support	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9	When humans interfere with nature it often produces disastrous consequences	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	Humans are severely abusing the environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	Plants and animals have as much right as humans to live	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12	Despite our special abilities, humans are still subject to the laws of nature	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13	The Earth is like a spaceship with very limited room and resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14	The balance of nature is very delicate and easily upset	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15	If things continue on their present course, we will soon experience a major ecological catastrophe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below are questions related to your view of others' opinions. Indicate the extent to which you agree with each of the statements provided by clicking on the appropriate response.

Subjective Norm:		Strongly Disagree	Mildly Disagree	Unsure	Mildly Agree	Strongly Agree
		1	2	3	4	5
16	Most people who are important to me would support my reducing energy usage within the next few months	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



## Environmental Behavior Survey

AN AIR FORCE INSTITUTE OF TECHNOLOGY SURVEY

### Section II:

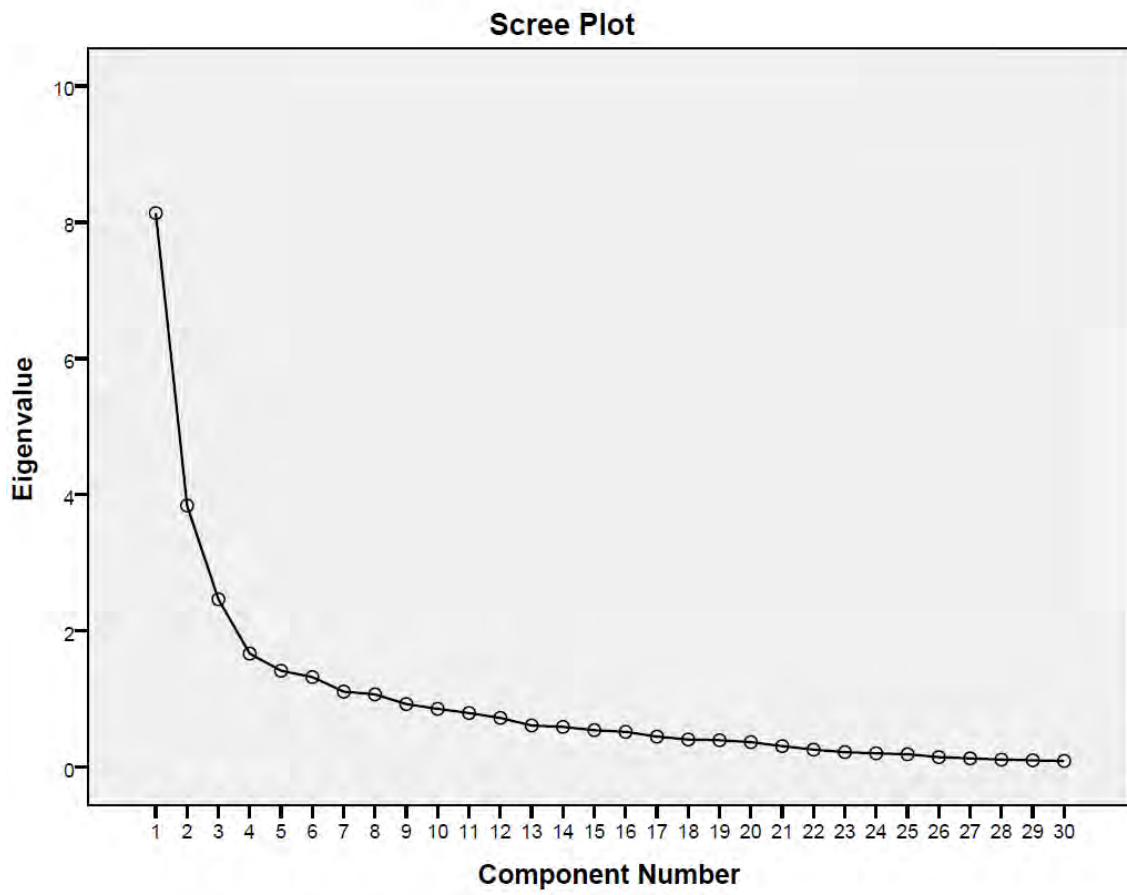
Below are questions related to your actual performance of specific actions. Indicate the extent to which you agree with each of the statements provided in regard to how often you actually perform these actions by clicking on the appropriate response.

Behavior:	Strongly Disagree 1	Mildly Disagree 2	Unsure 3	Mildly Agree 4	Strongly Agree 5
29 I could not be bothered to save water or other natural resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
30 In my daily life I'm just not interested in trying to conserve water and/or power	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
31 I drive whenever it suits me, even if it does pollute the atmosphere	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
32 I am NOT the kind of person who makes efforts to conserve natural resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
33 Even if public transportation was more efficient than it is, I would prefer to drive my own car.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
34 I make sure that during the winter the heating system in my room is not switched on too high	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
35 Whenever possible, I take a short shower in order to conserve water	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
36 I always switch the light off when I don't need it on any more	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
37 In my daily life I try to find ways to conserve water or power	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
38 Whenever possible, I try to save natural resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Below are questions related to how much control you believe you have over certain behaviors. Indicate the extent to which you agree with each of the statements provided by clicking on the appropriate response.

Perceived Behavioral Control:	Strongly Disagree 1	Mildly Disagree 2	Unsure 3	Mildly Agree 4	Strongly Agree 5
39 *Reducing my energy usage is inconvenient.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
40 I have plenty of opportunities to reduce my energy usage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
41 Reducing my energy usage is easy/a hassle.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
42 My unit provides satisfactory resources to reduce my energy usage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
43 I know what methods can reduce my energy usage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
44 I know where to go for help with reducing my energy usage.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Appendix C: Scree Plot



## Appendix D: Initial Exploratory Factor Analysis Results

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings <sup>a</sup>
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	8.135	27.116	27.116	8.135	27.116	27.116	5.683
2	3.842	12.807	39.923	3.842	12.807	39.923	5.036
3	2.466	8.221	48.144	2.466	8.221	48.144	4.571
4	1.668	5.560	53.703	1.668	5.560	53.703	3.920
5	1.417	4.723	58.426	1.417	4.723	58.426	4.301
6	1.324	4.412	62.837	1.324	4.412	62.837	2.691
7	1.110	3.701	66.538	1.110	3.701	66.538	2.456
8	1.070	3.566	70.104	1.070	3.566	70.104	1.277
9	.927	3.091	73.196				
10	.857	2.856	76.052				
11	.796	2.654	78.706				
12	.724	2.414	81.120				
13	.613	2.044	83.163				
14	.592	1.974	85.137				
15	.544	1.814	86.951				
16	.520	1.733	88.684				
17	.450	1.501	90.185				
18	.407	1.357	91.543				
19	.397	1.323	92.866				
20	.369	1.230	94.096				
21	.310	1.035	95.130				
22	.259	.862	95.992				
23	.222	.739	96.732				
24	.205	.682	97.413				
25	.191	.636	98.049				
26	.149	.495	98.544				
27	.130	.434	98.977				
28	.112	.374	99.352				
29	.102	.340	99.691				
30	.093	.309	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Pattern Matrix <sup>a</sup>								
	Component							
	1	2	3	4	5	6	7	8
Q8	<b>.888</b>	.016	-.020	-.080	-.178	-.309	.159	.040
Q9	<b>.782</b>	-.090	-.012	.012	-.058	.328	.003	.166
Q10	<b>.796</b>	-.158	-.034	.071	-.049	.244	.171	.117
Q11	.127	.240	-.029	-.207	<b>.769</b>	.054	-.167	-.138
Q12	.222	.146	.030	.123	.381	-.140	<b>-.460</b>	.282
Q13	<b>.678</b>	-.061	.152	.054	.152	-.225	-.030	-.038
Q14	<b>.751</b>	-.032	-.141	-.032	.134	.252	-.040	-.020
Q15	<b>.718</b>	.000	-.010	-.111	.290	.028	.009	-.101
Q16	.159	.099	.086	.100	-.074	<b>.744</b>	-.124	-.099
Q17	-.044	-.215	.113	.113	.259	<b>.693</b>	-.104	.248
Q20	.143	.118	.036	-.002	-.192	-.077	<b>.852</b>	.113
Q21	.070	.104	.157	.172	.109	-.249	<b>.698</b>	-.019
Q22	-.008	-.106	.039	.160	<b>.643</b>	.061	.092	-.371
Q23	.197	.064	<b>.502</b>	-.109	.245	-.073	-.029	-.233
Q24	-.078	-.025	<b>.654</b>	-.018	.348	.084	.119	.068
Q25	-.003	-.011	<b>1.010</b>	-.190	-.123	.097	.001	.166
Q26	-.085	.068	<b>.953</b>	-.040	-.045	.039	.042	.093
Q27	-.046	-.209	.381	.108	.185	.120	.343	-.016
Q28	.003	-.009	.299	.090	<b>.623</b>	.055	.001	-.188
Q34	-.107	<b>.786</b>	-.027	.060	-.094	-.172	.059	.027
Q35	-.015	<b>.646</b>	-.182	-.257	.307	.280	.251	.006
Q36	-.087	<b>.813</b>	.119	.052	.037	-.038	-.110	.161
Q37	-.013	<b>.875</b>	-.026	.026	.137	-.046	.114	.138
Q38	-.020	<b>.821</b>	.006	.065	.159	.107	.070	.053
Q40	.054	.138	-.083	<b>.635</b>	.323	-.079	.033	.155
Q41	.078	.225	.121	.042	-.396	.106	.083	<b>.884</b>
Q42	-.087	-.201	-.214	<b>.913</b>	.050	.002	.138	.156
Q43	.087	.287	.192	<b>.605</b>	-.149	.092	-.164	-.173
Q44	-.187	.175	-.048	<b>.650</b>	-.066	.283	-.006	-.037
Q45	.171	.294	-.022	<b>.584</b>	-.160	.031	.017	-.162

Extraction Method: Principal Component Analysis.  
Rotation Method: Promax with Kaiser Normalization.  
a. Rotation converged in 11 iterations.

## Appendix E: Final Exploratory Factor Analysis Results

Total Variance Explained							
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings <sup>a</sup>
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	6.191	30.956	30.956	6.191	30.956	30.956	4.727
2	3.215	16.076	47.032	3.215	16.076	47.032	4.730
3	1.969	9.845	56.877	1.969	9.845	56.877	3.083
4	1.489	7.447	64.324	1.489	7.447	64.324	3.309
5	1.300	6.500	70.824	1.300	6.500	70.824	2.661
6	.868	4.339	75.163				
7	.804	4.019	79.182				
8	.677	3.385	82.566				
9	.560	2.798	85.365				
10	.481	2.406	87.771				
11	.473	2.366	90.137				
12	.376	1.882	92.019				
13	.309	1.547	93.566				
14	.303	1.517	95.083				
15	.227	1.135	96.217				
16	.195	.977	97.194				
17	.174	.870	98.065				
18	.140	.699	98.764				
19	.135	.675	99.439				
20	.112	.561	100.000				

Extraction Method: Principal Component Analysis.

a. When components are correlated, sums of squared loadings cannot be added to obtain a total variance.

Pattern Matrix <sup>a</sup>					
	Component				
	1	2	3	4	5
Q8	<b>.859</b>	.028	-.035	-.037	-.371
Q9	<b>.759</b>	-.037	-.085	.052	.240
Q10	<b>.778</b>	-.087	-.041	.062	.219
Q13	<b>.758</b>	-.031	.196	.031	-.225
Q14	<b>.783</b>	-.001	-.116	.025	.170
Q15	<b>.799</b>	.052	.079	-.129	.057
Q16	.070	.072	.051	.233	<b>.613</b>
Q17	-.028	-.171	.122	.047	<b>.844</b>
Q24	.055	-.027	<b>.781</b>	-.038	.220
Q25	-.003	-.045	<b>.938</b>	-.090	.030
Q26	-.058	.039	<b>.911</b>	.026	.005
Q34	-.128	<b>.760</b>	-.058	.076	-.220
Q35	.036	<b>.721</b>	-.084	-.304	.393
Q36	-.028	<b>.798</b>	.068	.097	-.147
Q37	.041	<b>.912</b>	-.029	-.025	-.001
Q38	.037	<b>.857</b>	.032	.039	.093
Q42	.007	-.235	-.143	<b>.862</b>	.086
Q43	.070	.226	.173	<b>.704</b>	-.077
Q44	-.188	.114	-.027	<b>.719</b>	.248
Q45	.138	.253	-.021	<b>.652</b>	-.059

Extraction Method: Principal Component Analysis.

Rotation Method: Promax with Kaiser Normalization.

## Appendix F: Final Confirmatory Factor Analysis Results

Regression Weights: (Group number 1 - Default model)

	Estimate	S.E.	C.R.	P	Label
Q43.1 <--- PBC	.954	.090	10.541	***	par_1
Q44.1 <--- PBC	.926	.153	6.064	***	par_2
Q45.1 <--- PBC	1.000				
Q24.1 <--- Intention	.728	.081	9.007	***	par_3
Q25.1 <--- Intention	1.000				
Q26.1 <--- Intention	.894	.083	10.821	***	par_4
Q13.1 <--- Attitude	.828	.118	6.997	***	par_5
Q10.1 <--- Attitude	.999	.109	9.135	***	par_6
Q9.1 <--- Attitude	.890	.098	9.070	***	par_7
Q8.1 <--- Attitude	.743	.116	6.395	***	par_8
Q14.1 <--- Attitude	.876	.098	8.917	***	par_9
Q15.1 <--- Attitude	1.000				
Q36.1 <--- Behavior	.720	.068	10.559	***	par_10
Q37.1 <--- Behavior	.864	.063	13.613	***	par_11
Q38.1 <--- Behavior	1.000				
Q16.1 <--- SN	1.000				
Q17.1 <--- SN	.608	.198	3.080	.002	par_12

Standardized Regression Weights: (Group number 1 - Default model)

	Estimate
Q43.1 <--- PBC	.926
Q44.1 <--- PBC	.553
Q45.1 <--- PBC	.857
Q24.1 <--- Intention	.741
Q25.1 <--- Intention	.908
Q26.1 <--- Intention	.870
Q13.1 <--- Attitude	.649
Q10.1 <--- Attitude	.809
Q9.1 <--- Attitude	.803
Q8.1 <--- Attitude	.600
Q14.1 <--- Attitude	.792
Q15.1 <--- Attitude	.799
Q36.1 <--- Behavior	.765
Q37.1 <--- Behavior	.875
Q38.1 <--- Behavior	.953
Q16.1 <--- SN	.896
Q17.1 <--- SN	.471



Covariances: (Group number 1 - Default model)

		Estimate	S.E.	C.R.	P	Label
PBC	<--> Intention	.202	.111	1.824	.068	par_13
SN	<--> Intention	.342	.146	2.336	.020	par_14
SN	<--> Behavior	.346	.097	3.561	***	par_15
Attitude	<--> Behavior	.362	.108	3.357	***	par_16
Intention	<--> Behavior	.269	.133	2.021	.043	par_17
SN	<--> PBC	.299	.083	3.592	***	par_18
SN	<--> Attitude	.456	.121	3.785	***	par_19
PBC	<--> Attitude	.207	.086	2.399	.016	par_20
PBC	<--> Behavior	.420	.085	4.943	***	par_21
Intention	<--> Attitude	.475	.165	2.879	.004	par_22

Squared Multiple Correlations: (Group number 1 - Default model)

	Estimate
Q17.1	.222
Q16.1	.803
Q38.1	.907
Q37.1	.766
Q36.1	.586
Q8.1	.360
Q9.1	.644
Q10.1	.654
Q13.1	.421
Q14.1	.627
Q15.1	.639
Q26.1	.757
Q25.1	.824
Q24.1	.548
Q45.1	.734
Q44.1	.306
Q43.1	.857

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	61	200.231	109	.000	1.837
Saturated model	170	.000	0		
Independence model	17	1175.358	153	.000	7.682

Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.830	.761	.914	.875	.911
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Parsimony-Adjusted Measures

Model	PRATIO	PNFI	PCFI
Default model	.712	.591	.649
Saturated model	.000	.000	.000
Independence model	1.000	.000	.000

RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.062	.048	.076	.070
Independence model	.176	.167	.185	.000

## Appendix G: T-Test Analysis Results

Base X Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Low er	Upper			
Pair 1	Att Time 1 - Att Time 2	-.17512	.79103	.06885	-.31132	-.03891	-2.543	131	.012
Pair 2	Att Time 2 - Att Time 3	.10485	.75492	.06571	-.02513	.23484	1.596	131	.113
Pair 3	Att Time 1 - Att Time 3	-.07026	.87556	.07621	-.22102	.08049	-.922	131	.358
Pair 4	SN Time 1 - SN Time 2	-.36128	.79963	.06960	-.49897	-.22360	-5.191	131	.000
Pair 5	SN Time 2 - SN Time 3	.22856	.70973	.06177	.10636	.35076	3.700	131	.000
Pair 6	SN Time 1 - SN Time 3	-.13272	.88758	.07725	-.28555	.02010	-1.718	131	.088
Pair 7	Int Time 1 - Int Time 2	-.05442	1.13812	.09906	-.25038	.14155	-.549	131	.584
Pair 8	Int Time 2 - Int Time 3	.27000	.96236	.08376	.10430	.43571	3.223	131	.002
Pair 9	Int Time 1 - Int Time 3	.21559	1.17350	.10214	.01353	.41764	2.111	131	.037
Pair 10	Beh Time 1 - Beh Time 2	.29389	.79551	.06924	.15692	.43086	4.244	131	.000
Pair 11	Beh Time 2 - Beh Time 3	-.09115	.81061	.07055	-.23073	.04842	-1.292	131	.199
Pair 12	Beh Time 1 - Beh Time 3	.20273	.79501	.06920	.06585	.33962	2.930	131	.004
Pair 13	PBC Time 1 - PBC Time 2	.21000	.65078	.05664	.09795	.32205	3.707	131	.000
Pair 14	PBC Time 2 - PBC Time 3	-.10854	.53331	.04642	-.20037	-.01672	-2.338	131	.021
Pair 15	PBC Time 1 - PBC Time 3	.10146	.66108	.05754	-.01237	.21528	1.763	131	.080

Base Y Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Att Time 1 - Att Time 2	-.1356	.76769	.08327	-.30116	.03001	-1.628	84	.107
Pair 2	Att Time 2 - Att Time 3	.0972	.67609	.07333	-.04861	.24305	1.326	84	.189
Pair 3	Att Time 1 - Att Time 3	-.0384	.66917	.07258	-.18269	.10598	-.528	84	.599
Pair 4	SN Time 1 - SN Time 2	.0946	.69261	.07512	-.05475	.24404	1.260	84	.211
Pair 5	SN Time 2 - SN Time 3	.1014	.61895	.06713	-.03212	.23489	1.510	84	.135
Pair 6	SN Time 1 - SN Time 3	.1960	.60310	.06542	.06595	.32612	2.997	84	.004
Pair 7	Int Time 1 - Int Time 2	.0379	.95787	.10390	-.16872	.24449	.365	84	.716
Pair 8	Int Time 2 - Int Time 3	-.0935	1.00114	.10859	-.30946	.12242	-.861	84	.392
Pair 9	Int Time 1 - Int Time 3	-.0556	.87697	.09512	-.24479	.13352	-.585	84	.560
Pair 10	Beh Time 1 - Beh Time 2	.1857	.73143	.07934	.02795	.34348	2.341	84	.022
Pair 11	Beh Time 2 - Beh Time 3	-.1222	.71628	.07769	-.27672	.03227	-1.573	84	.119
Pair 12	Beh Time 1 - Beh Time 3	.0635	.48782	.05291	-.04173	.16871	1.200	84	.234
Pair 13	PBC Time 1 - PBC Time 2	.0067	.59094	.06410	-.12078	.13415	.104	84	.917
Pair 14	PBC Time 2 - PBC Time 3	-.0620	.56900	.06172	-.18471	.06075	-1.004	84	.318
Pair 15	PBC Time 1 - PBC Time 3	-.0553	.64629	.07010	-.19469	.08411	-.789	84	.432

## Appendix H: IRB Exemption Letter



**DEPARTMENT OF THE AIR FORCE  
AIR FORCE INSTITUTE OF TECHNOLOGY  
WRIGHT-PATTERSON AIR FORCE BASE OHIO**

10 June 2011

MEMORANDUM FOR DR. ALFRED THAL

FROM: William A. Cunningham, Ph.D.  
AFIT IRB Research Reviewer  
2950 Hobson Way  
Wright-Patterson AFB, OH 45433-7765

SUBJECT: Approval for exemption request from human experimentation requirements (32 CFR 219, DoDD 3216.2 and AFI 40-402) for study on evaluating the effectiveness of educational programs in affecting environmental attitudes

1. Your request was based on the Code of Federal Regulations, title 32, part 219, section 101, paragraph (b) (2) Research activities that involve the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior unless: (i) Information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) Any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.
2. Your study qualifies for this exemption because you are not collecting sensitive data, which could reasonably damage the subjects' financial standing, employability, or reputation. Further, the demographic data you are collecting cannot realistically be expected to map a given response to a specific subject.
3. This determination pertains only to the Federal, Department of Defense, and Air Force regulations that govern the use of human subjects in research. Further, if a subject's future response reasonably places them at risk of criminal or civil liability or is damaging to their financial standing, employability, or reputation, you are required to file an adverse event report with this office immediately.

//ORIGINAL SIGNED//

WILLIAM A. CUNNINGHAM, PH.D.  
AFIT Research Reviewer

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## **Vita**

Captain Jeremy P. Kinne graduated in the class of 2001 from Grand Forks Central High School in Grand Forks, North Dakota. He entered undergraduate studies at the University of Texas at Austin where he graduated with a Bachelor of Science in Architectural Engineering in May 2005.

His first job was working for L. A. Fuess Inc. in Dallas, Texas as a structural engineer-in-training. His duties included checking shop drawings, creating computer models of current designs, and performing structural design calculations for new buildings. In the summer of 2006, he was accepted to Officer Training School in Montgomery, Alabama and was commissioned into the United States Air Force.

His first assignment was as Chief of Construction at 61st Civil Engineer and Logistics Squadron, Los Angeles AFB, California. From March 2009 to Nov 2009, he deployed to Kabul, Afghanistan International Airport in Kabul, Afghanistan in support of International Security Assistance Forces (ISAF). There, he served as a civil engineer responsible for design, layout, logistics, and construction of any requirements dealing with the migration of base populace to the new ISAF Joint Command Headquarters. Upon returning to Los Angeles AFB, he became the Operations Flight Commander. In August 2010 he entered the Graduate School of Engineering and Management, Air Force Institute of Technology, where he earned a Master's of Science degree in Engineering Management. Upon graduation, he will be assigned to Shaw Air Force Base in Sumter, South Carolina.

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14. ABSTRACT New federal mandates require federal entities to reduce resource usage across the board. Additionally, commercial enterprises are evaluating methods of reducing resource consumption to reduce costs and become more ecologically friendly. In response, researchers have begun to evaluate the intentions and behaviors of individuals to determine how to encourage individual participation in reduction methods. This study used a quasi-experimental design of non-equivalent groups to evaluate the effects of Computer Based Training and persuasive speech on individual environmental attitudes and behavior. Using the Theory of Planned Behavior model to determine intentions and behaviors, this study utilized surveys to evaluate the relative effects of the interventions. The results provide managers with information that can help determine how to use intervention in their organizations to effectively change individual attitudes, intentions, and behaviors with respect to resource reduction. A key finding of this study was that Computer Based Training appears to have no short or long-term effects on environmental cognitive processes. Additionally, it was found that a persuasive speech was able to increase an individual's subjective norm which then showed a moderate link to long-term environmentally friendly behavior.					
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